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USNS Hayes marine fog cruise preliminary evaluation of Naval Postgraduate School data

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NAVAL POSTGRADUATE SCHOOL

Monterey, California

USNS HAYES MARINE FOG CRUISE:
PRELIMINARY EVALUATION OF
NAVAL POSTGRADUATE SCHOOL DATA

Gordon Schacher

2 April 1976

Preliminary Report for period July 1975 to July 1976

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Monterey, California

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This report summarizes the participation of the Naval Postgraduate School aboard the USNS Hayes on a marine fog cruise in the North Atlantic. The equipment which was installed aboard the ship and the types of measurements which were made are described. Tables of the mean data taken are presented as well as some preliminary evaluation of the data.

ABSTRACT

This report summarizes the participation of the Naval Postgraduate School aboard the USNS Hayes on a marine fog cruise in the North Atlantic. The equipment which was installed aboard the ship and the types of measurements which were made are described. Tables of the mean data taken are presented as well as some preliminary evaluation of the data.

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I. INTRODUCTION

In the summer of 1975 Naval Air Systems Command, Code 370, sponsored a marine fog research cruise aboard the Naval Research Laboratory (NRL) ship, USNS Hayes, in the Nova Scotia area. The cruise involved scientific personnel from several laboratories, including the Naval Postgraduate School (NPS). Many of us who were on the Hayes had previously participated in Pacific Ocean cruises off the California coast and this was our first opportunity to study marine fog in the Atlantic. The time and location for this cruise were chosen to give us maximum probability of encountering fog, and were well chosen as we spent a large fraction of the time in the fog.

We left Chetham Annex, Virginia on July 28 and arrived on station just south of the western tip of Nova Scotia on July 31 at 1100 and began operations. We sailed various patterns in and out of the fog in the area to the south of, and for the full length of Nova Scotia until August 7 when we changed operations to the Grand Banks area. We operated near the Grand Banks until August 11, again encountering considerable fog. We docked at Halifax before noon on the 11th and this completed the cruise for NPS.

NPS participated in the cruise primarily to gather turbulence data for a wide range of atmospheric conditions, including times when we are in and out of the fog. These data are to be used to determine turbulent fluxes of heat, momentum, and water vapor. These parameters are needed as inputs for existing marine fog models, and are not available at the present time.

This report is not meant to be a complete description of the experimental work that was carried out during the Hayes cruise; such a report is being written by NRL. Here we include a description of the equipment NPS installed aboard the ship and preliminary evaluation of some of the mean data obtained.

II. USNS HAYES INSTALLATION

The USNS Hayes (T-AGOR 16) is a twin hull ship that was constructed for NRL for use as an oceanographic research vessel. Pertinent dimensions are: length overall 246 ft, beam 75 ft, and distance between hulls 27 ft. Due to the catamaran construction the ship has a very broad forward wall beginning approximately 50 ft back from the bows of the ship, which extends nearly the full width of the ship and to a height of approximately 56 ft above the mean water line. The presence of this wall greatly perturbs the natural airflow and causes problems in the interpretation of our data, as will be described below.

Figure 1 shows the profile of the ship and the location of the two stations at which NPS installed sensors. We welded a 12 ft tubular steel tower as far forward on the bow as possible (approximately 2 ft back from the tip of the bulwark). The mean sensors were placed at the top of this tower and the turbulence sensors were mounted on a wind vane, which was mounted on a 4 ft extension at the top of the tower. The vane is used to keep the sensors pointing into the wind, and the extension places the sensors forward of the tower so that shipboard influence is eliminated. The second station was located on the first level of the ships mast. Again the turbulence sensors were mounted on a vane on an extension to keep these sensors as far forward of the platform as was feasible. The arrangement at this station was such that the mean sensors were approximately 2 ft below the turbulence sensors. The height of the various sensors above the mean water level were

	Sensor Height		Air Height	
Station	Mean	Turbulence	Mean	Turbulence
Bow	40 ft	40 ft	37 ft	37 ft
Mast	78.5 ft	81 ft	58 ft	61 ft

Table 1. Height of Sensors above Mean Sea Level.

Figure 1 shows a schematic representation of the air flow over the ship when the relative wind is from the bow. The effect of the flow is that the air sampled by the sensors at the mast station comes from a height lower than their actual height above the sea surface. The location of the bow station is such that the air sampled comes from the same height as the sensors.

Before the fog cruise NRL had a wind tunnel analysis of the air flow around the Hayes performed. Also, during the cruise Dr. Richard Jeck of NRL made a number of measurements of the wind velocity in the forward region of the ship with a bivanne animometer. Evaluation of these two sets of data do not give us as accurate information as we need, but they do show that the air arriving at the mast rises approximately 20 ft. This correction is applied to the height, giving the air height listed in Table 1. Note that the air flow information that is available is only for the relative wind directly from the bow.

The ship influence creates a serious problem in one method of determining fluxes. An estimated of momentum flux can be obtained from the variation of mean wind speed with height. We have used this method for preliminary evaluation of our data and find that the results are not satisfactory. The wind speed we measure at the mast is too high due to the compressive flow over the large forward wall of the ship. We could correct the measured speed if we knew the divergence of the air to the sides of the ship as well as the compression over the top. We will probably not be able to use this method for the data acquired on the Hayes cruise.

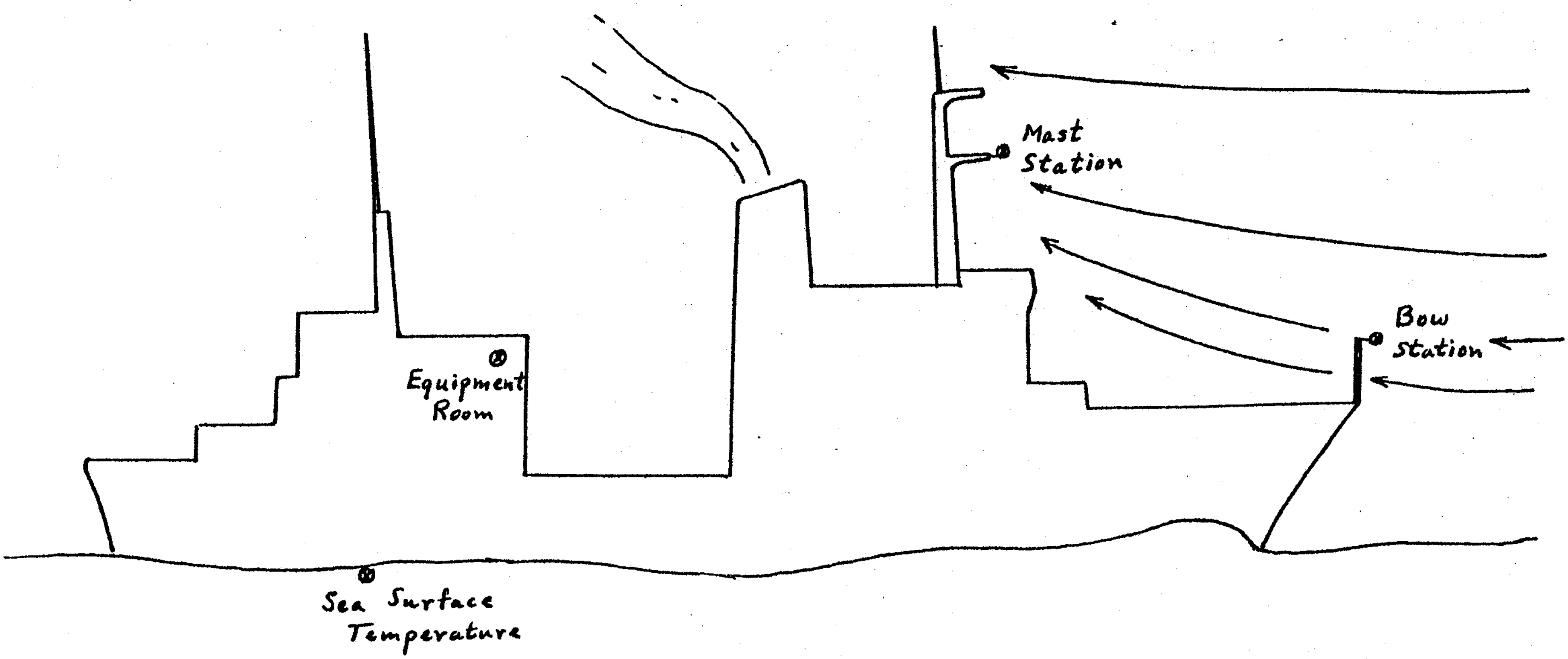

Figure 1. Location of NPS Equipment on USNS Hayes

III) NPS Equipment

1) General Information

We installed equipment to measure both mean and turbulence parameters at both the bow and mast stations. The parameters measured were:

humidity

temperature

horizontal wind speed

temperature fluctuations

horizontal wind speed fluctuations

A sea surface temperature sensor was installed at the starboard side about 50 ft forward of the stern.

In order to obtain a complete set of wind measurements, Jim Russell of the Naval Avionics Facility (NAFI) installed wind direction indicators at both experimental stations.

Details of the equipment used for the measurements follows.

The sensors for both mean humidity and mean temperature were mounted in a single aspirator at each station. They were, therefore, protected from the weather while a steady flow of air insured that they remained at ambient conditions.

2) Humidity:

A Hygrodynamics Digital II system employing 15-1818 sensors was used. The sensors contain lithium chloride cells and thermistors so that humidity and temperature were both measured continuously. This temperature sensor was used only as a monitor, not for our mean temperature measurements. The humidity sensors were calibrated in a chamber containing saturated salt solutions; the results are shown in Table 2 and the resultant calibration curves are shown in Figure 2.

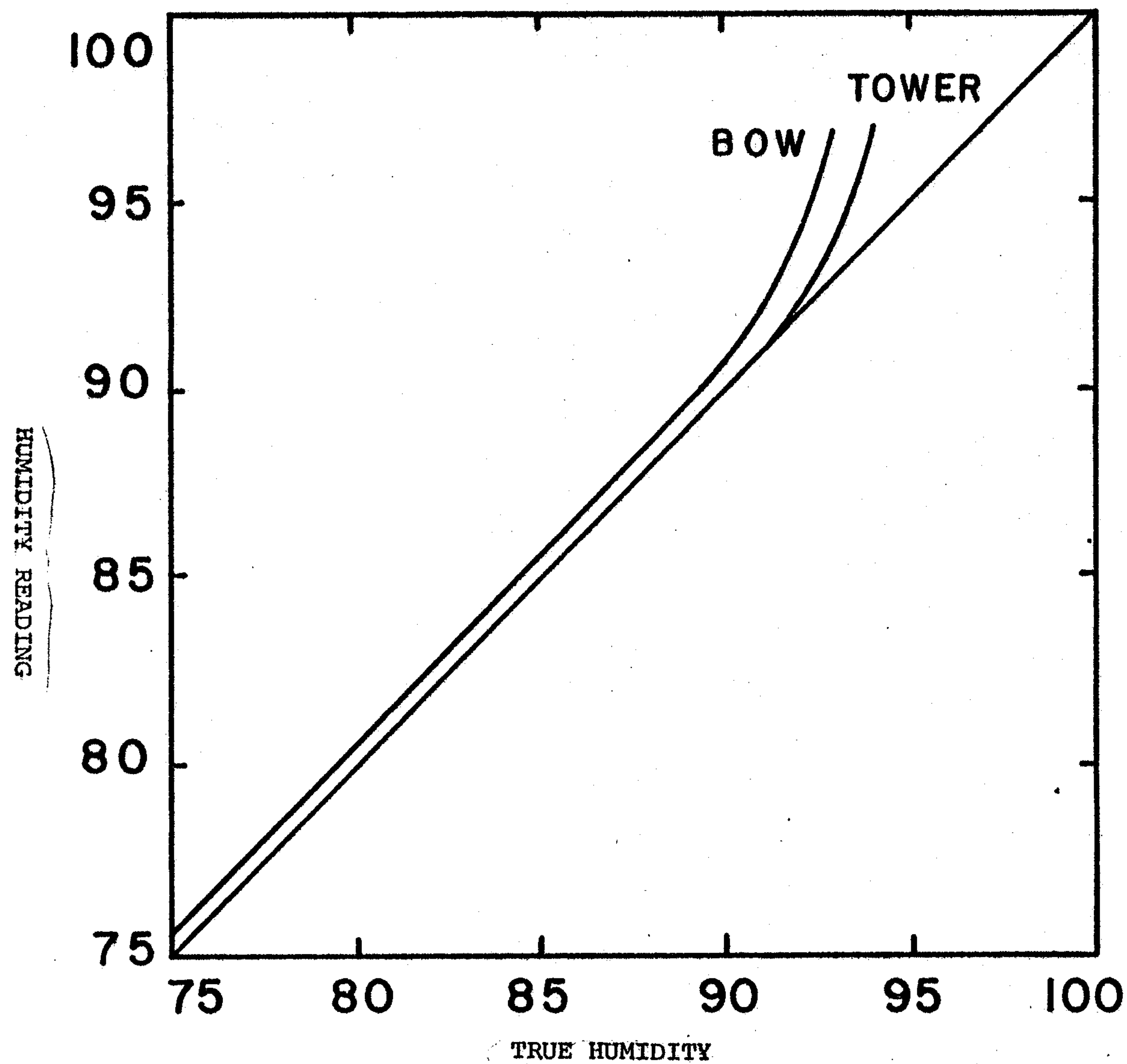

FIGURE 2. HUMIDITY CALIBRATION

Solution	Sensor	True Humidity	Humidity Reading	Error
NaCl	Bow	75.6	75.2	- 0.4
	Tower	75.6	75.6	0
$(NH_4)_2SO_4$	Bow	80.1	79.8	- 0.3
	Tower	80.1	80.0	- 0.1
KNO_3	Bow	91.2	90.4	- 0.8
	Tower	91.2	91.1	- 0.1
K_2SO_4	Bow	96.7	92.9	- 3.8
	Tower	96.8	93.8	- 3.0

Table 2. Humidity sensor calibrations

3) Mean Temperature:

Hewlett Packard Model 2801A. In this system the sensor is a quartz crystal which forms the capacitative element in an oscillator tank circuit. Temperature changes change the oscillator frequency, which is sensed for the temperature readout. This system is quite accurate, allowing temperatures to be determined within 0.03°C. Sea surface temperature is measured with the same system.

4) Mean Wind Speed:

Thornthwaite Model 101 Wind Register System. This is a photoelectric system with very light plastic cups that allow measurement of winds as slight as one half knot.

5) Temperature Fluctuations:

A low power ac Wheatstone bridge was constructed using a GTE Sylvania Inc. Model 140 Lightweight Thermo-sonde System with TSI Model 1210 probes with P.8 platinum wire were used as the sensing elements. The low power bridge was operated at 100μAmp, the resistances of the probes were approximately 40 Ohms, thus, the energy dissipation in the sensor is 5×10^{-7} Watts. Very low power was used to ensure that the sensor is not elevated above ambient temperature which prevents velocity fluctuations from influencing the wire response. The wire is 1.2 mm long and 2.5μ in diameter, and the probe has a time constant much shorter than the times encountered in atmospheric turbulence.

6) <u>Wind Speed Fluctuations:</u>

TSI Model 1054B Anemometer; TSI Model 1210 probes with T1.5 tungsten wire were used as the sensing elements. The tungsten wire was 4.5μ in diameter. An overheat ratio of 1.5 was utilized so that the wire temperature was approximately 300°C. The overheat greatly diminishes the influence of temperature fluctuations on these measurements.

The axes of the wires were aligned in the vertical direction so that the wires were not sensitive to air flow in the vertical direction. Thus, only the horizontal component of wind speed fluctuations is detected.

7) <u>Data Recording Equipment:</u>

Fluctuation data, both the direct and differentiated signals for temperature and wind speed, were recorded on one inch magnetic tape.

Mean wind data was both recorded by hand and recorded and processed by the NRL shipboard computer. The mean temperature and humidity were printed on paper tape with a Hewlett Packard 562AR printer. Towards the end of the cruise the mean temperature was recorded by the NRL computer, beginning at 1330 on August 7.

In order to correctly understand the mean temperature data it is necessary to describe the data gathering sequence in some detail. There are five signals to record: humidity at two levels and temperature at three levels, including the sea surface. These signals are processed by a homemade sequencer which sorts and sends the signals to the printer. The sequencer steps cyclically from level to level in the sequence: sea surface → bow → mast, and the temperature and humidity at a given level are printed simultaneously. When the sequencer is at the sea surface step zeros are printed for the humidity and this allows us to identify the levels on the print tape.

The interfacing between the sequencer and the Hewlett Packard temperature readout posed some problems. Since the readout is a frequency counter it has its own count cycle, the timing of which is set by a front panel control. It was not possible to control the readout timing by a command from the sequencer and we did not construct the sequencer to accept a command from the readout. Thus, it is possible for the sequencer to issue a print command when the counter is in a read cycle, leading to an error. We set the readout timer in a way so that such errors are very infrequent and they are normally easily identified.

Interfacing the sequencer with the NRL computer presented much the same problem. The sequencer print command was used as the read command for the computer, but there was no signal available to tell the computer which level was being read. This circumstance occurred because the sequencer was not designed to operate with a computer and the interfacing was done at the last moment when we learned that computer channels would be available to us. In order to correctly identify the level being read it was necessary to synchronize the computer and sequencer by starting the computer read when the sea surface temperature was being presented. We monitored the synchronization frequently since jumping out did occur on a few occasions.

Due to interface incompatibility it was not possible to read the humidity data into the computer

The three mean temperatures and the two mean humidities were read and recorded every 2.5 minutes throughout the cruise except when a malfunction occurred. Fluctuation data was recorded at frequent, but irregular intervals, as conditions warrented. The times when these recordings were made is shown in table #4. The mean wind velocities for both levels were recorded at one minute intervals by the NRL computer.

IV) PRELIMINARY DATA

1) Navigation Charts

Charts of the ships position in the Nova Scotia area were drawn during this cruise by this investigator for the fun of learning how it is done and the results turned out to be quite useful. The charts are shown in Figure 3 and 4. These charts were constructed by a combination of Loran C from the scientific navigation room, the ship's log, radar fixes, Loran A from the bridge, and by some seat of the pants dead reckoning. It had been planned to use only the Loran C system for chart preparation but the area below Nova Scotia is a poor area for its use and we encountered difficulties such as jumping bands and areas where the system would not lock on. For constructing the chart the computer readout of the Loran C fixes was primarily used up until August 3rd, when the system began to behave poorly. From this point on the chart was constructed by correcting the computer readout with radar fixes, and the ship's log of the times at which course changes were made, using the ship's speed. The second chart, Figure 4, which is of the Ground Banks area, was made entirely from the ship's log and the bridge charts. It is easily seen that the two charts don't quite fit together. No attempt has been made to correct this. The data used from the bridge log in constructing the charts is shown in Table 3. Note that the ship's log is on local time and all charts and data are logged with respect to Eastern Standard Time. There was a time zone change on August 7th.

Table 3. Data from the Ship's Log used in Chart Preparation

8/2/75	Positions	0800	$42^{\circ}56'$, $62^{\circ}26'$
		1200	$43^{\circ}24'$, $63^{\circ}14'$
		2000	$43^{\circ}59'$, $63^{\circ}42'$

0010 Change course to 060°

0035 Engines slow

0055 Resume speed

0830 Change course to 299°

0900 Change course to 300°

1009 Change course to 301°

1300 Ship stopped

1545 Full ahead at 280°

1620 Change course to 300°

1705 Change course to 287°

1805 Change course to 060°

2148 Change course to 240°

2315 Change course to 180°

8/3/75	Positions	0800	43° 37', 63° 57'
		1200	44° 02', 63° 30'
		2000	44° 53', 61° 22'

0405 Change course to 345°

0901 Change course to 060°

1615 Change course to 064°

2120 Reduce speed (95 rpm)

2210 Change course to 194°

2230 Resume speed (125 rpm)

8/4/75	Positions	0800	44° 28', 62° 04'
		1200	44° 20', 62° 14'
		2000	44° 12', 62° 31'

0210 Change course to 192°

	0402	Change course to 310°	
	0840	Change course to 100°	
	0949	Ship stopped	
	1030	Full ahead	
	1035	Change course to 270°	
	1500	Change course to 180°	
	1550	Change course to 270°	
	1630	Ship stopped	
	1650	Resume speed	
	2055	Change course to 180°	
	2300	Ships stopped	
	2320	Resume speed	

8/5/75	Positions	0800	43° 52', 64° 08'
		1200	44° 11', 63° 10'
		2000	44° 52', 61° 06'
	0230	Change course to 300°	
	0745	Change course to 060°	
	0920	Change course to 055°	
	1017	Change course to 062°	
	1340	Change course to 075°	
	1412	Decrease speed to 8 knots	
	1500	Change course to 062°, resume 12 knots speed	
	2110	Change course to 064°	

8/6/75	Positions	0800	44° 46', 60° 52'
		1200	44° 20', 61° 54'
		2000	44° 28', 62° 29'

0200 Change course to 180°

0300 Change course to 242°

1410 Change course to 240°

1530 Change course to 242°

1745 Change course to 060°

2115 Change course to 062°

2220 Change course to 064°

8/7/75	Positions	0800	$45^\circ 06'$, 59° $16'$	Advance clocks 20 min. at 0100, 0500, and 1100 going into new time zone.
		1200	$45^\circ 05'$, 58° $06'$	
		2000	$45^\circ 20'$, 56° $11'$	

0200 Change course to 90°

1410 Change course to 88°

1510 Change course to 86°

1850 Change course to 0°

1900 Reduce speed (110 rpm)

1930 Reduce speed (100 rpm)

2015 Ship stopped

2032 Resume speed

2215 Change course to 270°

2245 Change course to 180°

8/8/75	Positions	0800	$44^\circ 49'$, $56^\circ 10'$
		1200	$45^\circ 21'$, $56^\circ 11'$
		2000	$45^\circ 17'$, $56^\circ 33'$

0610 Change course to 090°

0640 Change course to 0°

1345 Change course to 270°

	1445 Change course to 180°		
	1808 Change course to 270°		
	1850 Change course to 0°		
	2200 Change course to 270°		
	2300 Change course to 180°		

8/9/75	Positions	0800	$44^\circ 58'$, $56^\circ 56'$
		1200	$45^\circ 35'$, $56^\circ 45'$
		2000	$44^\circ 54'$, $56^\circ 11'$
	0210 Change course to 182°		
	0310 Change course to 180°		
	0455 Change course to 270°		
	0550 Change course to 0°		
	1200 Change course to 090°		
	1545 Change course to 180°		

8/10/75	Positions	0800	$43^\circ 46'$, $56^\circ 32'$
		1200	$44^\circ 23'$, $56^\circ 36'$
		2000	$45^\circ 10'$, $57^\circ 00'$
	0450 Change course to 270°		
	0645 Change course to 0°		
	1135 Change course to 002°		
	1210 Change course to 002°		
	1410 Change course to 005°		
	1510 Change course to 360°		
	1728 Change course to 263°		
	1728 Change course to 265°		

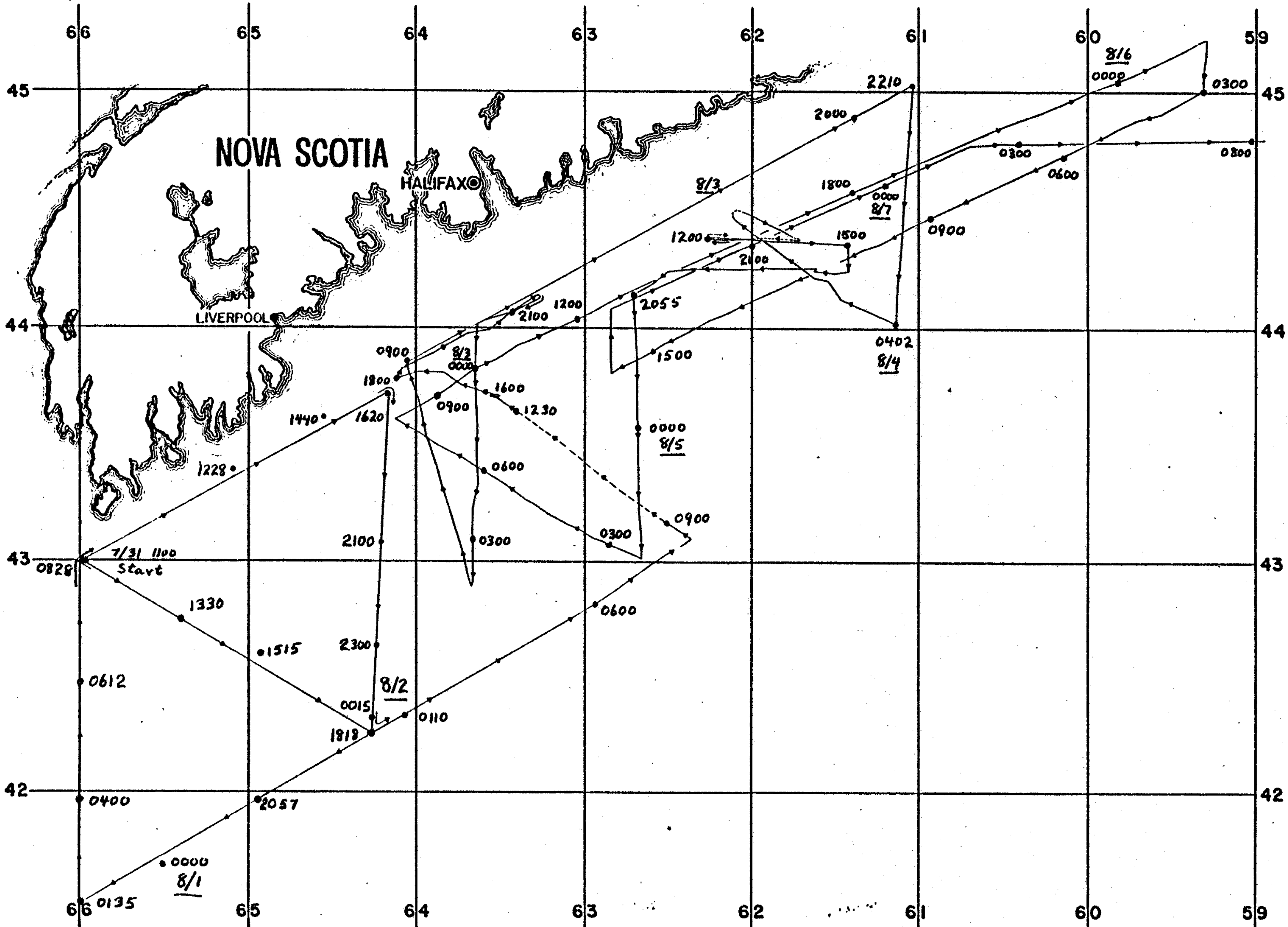

Figure 3. Ships Position 7/31-8/7/75

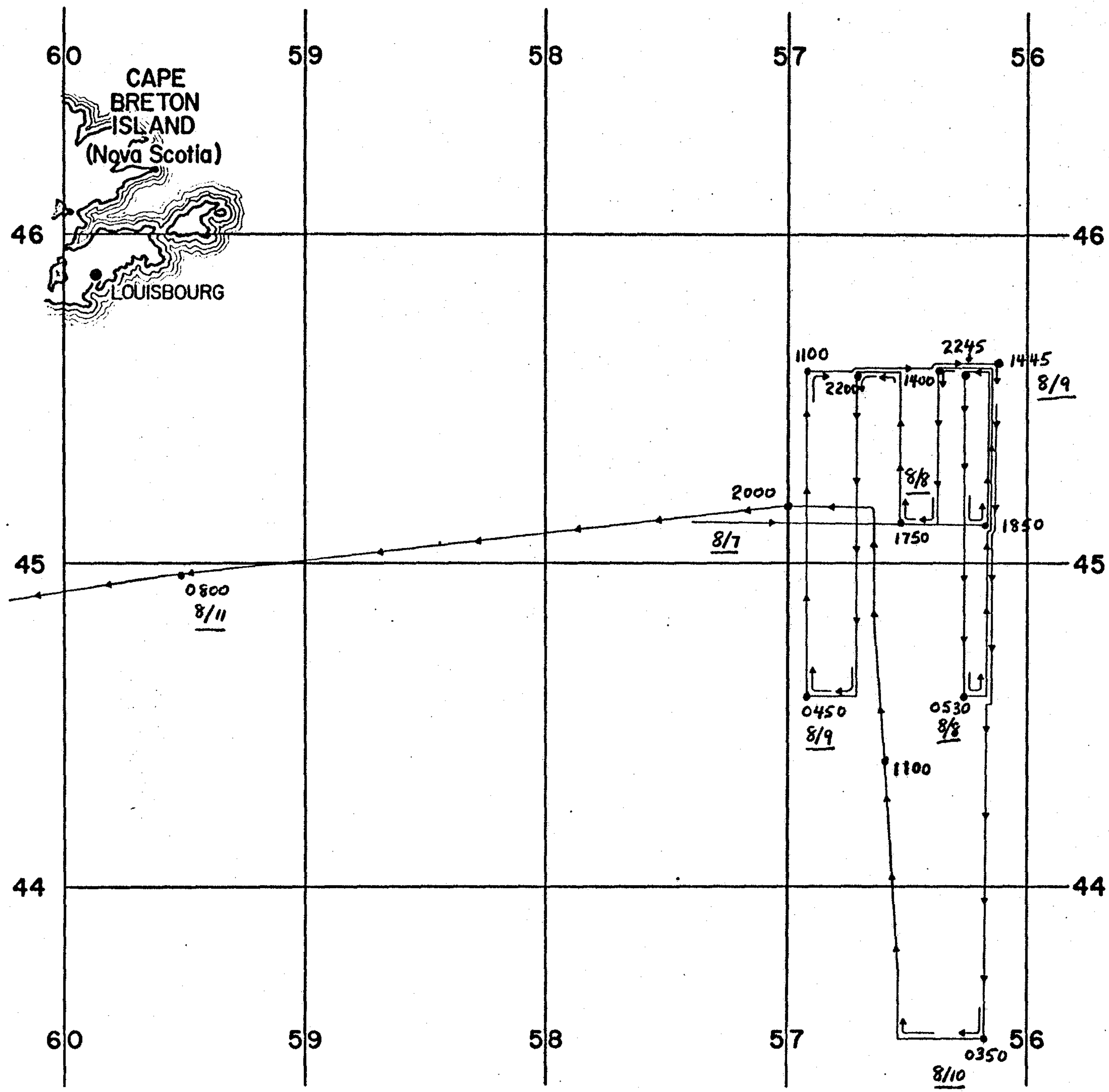

Figure 4. Ships Position 8/7-8/11/75

Table 4. Recorded Temperature and Humidities

Time	T_s	T_1	T_2	H_1	H_2
7/29					
1330	25.21	25.20	25.20	85.6	84.1
1400	-	-	-	86.1	84.1
1430	25.37	-	25.37	85.9	84.0
1500	-	-	-	85.3	83.9
1530	-	-	-	84.4	83.9
1600	24.50	24.54	24.54	84.6	85.9
1630	25.34	25.34	25.37	84.7	84.9
1700	25.32	25.30	25.25	85.0	85.2
1730	25.25	25.20	25.24	86.2	86.5
1800	25.04	25.05	25.04	87.9	87.9
1830	-	-	-	87.0	87.0
1900	25.44	25.47	25.44	86.9	87.3
1930	25.50	25.45	25.45	87.4	87.6
2000	25.70	25.71	25.71	89.1	89.7
2030	-	-	-	-	-
2100	25.79	25.79	25.79	88.4	89.0
2130	25.34	25.34	25.33	88.3	88.5
2200	25.30	25.31	25.30	88.1	87.8
2230	23.67	23.66	23.66	91.0	91.3
2300	23.35	23.34	23.34	91.5	91.5
2330	23.30	23.29	23.28	89.2	89.0
7/30					
0000	23.17	23.17	23.17	72.2	72.5
0030	23.29	23.25	23.28	69.8	70.0
0100	23.17	23.15	23.16	67.3	66.3
0130	23.31	23.31	23.32	61.9	61.1
0200	23.54	23.54	23.54	63.4	63.8
0230	23.98	23.97	23.99	66.0	66.3
0300	22.57	22.56	22.56	86.2	84.8
0330	23.91	23.90	23.90	74.0	73.2
0400	23.98	23.98	23.98	61.7	60.0
0430	23.89	23.87	23.87	65.7	65.8
0500	23.76	23.75	23.74	62.0	61.5

Time	T_s	T_1	T_2	H_1	H_2
0530	23.73	23.73	23.74	65.3	64.6
0600	23.80	23.80	23.81	65.8	65.7
0630	24.09	24.09	24.08	69.9	-
0700	23.73	23.72	23.72	72.0	70.6
0730	-	23.17	23.17	73.9	72.2
0800	23.23	-	23.24	74.2	72.4
0830	21.93	21.92	21.93	72.8	71.3
0900	21.84	21.84	21.84	74.7	73.5
0930	-	20.31	-	84.1	79.9
1000	19.76	20.60	-	78.2	75.9
1030	21.14	21.13	21.16	77.8	75.6
1100	21.97	21.97	21.98	78.1	75.9
1130	21.40	21.33	21.52	73.8	72.6
1200	21.38	21.37	21.37	73.8	72.6
1230	20.88	20.85	20.88	74.5	73.3
1300	20.74	20.71	20.71	76.2	74.3
1330	21.12	20.72	20.67	71.8	70.9
1400	21.23	21.17	21.33	71.1	70.3
1430	19.72	20.13	19.83	71.6	71.5
1500	22.20	22.14	21.97	64.0	65.1
1530	20.76	20.65	21.00	68.7	69.6
1600	21.04	21.11	20.98	74.4	75.2
1630	19.74	19.84	19.40	74.3	75.3
1700	18.42	18.88	18.96	78.7	76.1
1730	19.94	19.93	19.90	79.5	79.8
1800	-	-	-	-	-
1830	-	-	-	-	-
1900	15.59	15.51	15.64	88.9	88.5
. . .					
2200	16.49	16.49	16.48	90.0	90.3
. . .					
7/31					
1100	10.02	13.90	14.94	95.3	90.7

Time	T_s	T_1	T_2	H_1	H_2	
1130	9.69	13.39	-	93.8	92.7	
1200	-	-	-	-	-	
1230	-	-	-	-	-	
1300	11.17	13.00	-	93.2	92.4	
1330	11.28	13.56	14.09	93.4	92.5	
. . .						
1630	13.43	14.85	15.03	92.0	92.4	31-1
1700	13.73	14.32	14.58	92.5	93.4	
1730	14.19	14.97	15.54	93.4	91.9	
1800	14.09	-	15.83	92.2	91.0	
1830	12.78	14.76	15.28	92.5	91.9	31-2
1900	11.89	-	15.70	93.0	90.6	
1930	11.45	14.38	15.25	92.2	92.0	
2000	15.52	16.06	16.17	94.8	92.2	
2030	17.69	17.16	17.21	92.5	91.0	31-3
2100	19.96	17.52	17.42	91.5	90.4	
2130	17.25	17.90	18.00	81.1	87.8	
2200	17.34	17.24	17.31	90.8	90.4	
2230	21.00	18.36	18.08	89.5	89.0	31-4
2300	20.55	18.44	18.43	86.9	86.8	31-5
2330	20.78	18.01	17.93	88.9	88.9	31-6
8/1						
0000	20.17	18.42	18.36	86.9	86.6	
0030	19.63	18.56	18.50	86.8	86.6	1-1
0100	16.32	16.68	16.99	88.5	88.5	
0130	15.28	16.18	16.53	91.3	90.7	
0200	14.65	15.91	16.53	91.2	89.0	1-2
0230	15.54	16.18	16.51	90.1	88.0	
0300	15.36	16.20	16.50	90.0	87.3	1-3
0330	-	-	-	-	-	
0400	-	-	-	-	-	
0430	16.35	16.39	16.53	77.6	74.5	1-4
0500	15.83	16.32	16.64	75.4	70.3	
0530	14.89	16.15	16.55	74.6	72.1	1-5

Time	T_s	T_1	T_2	H_1	H_2	
.						
.						
.						
0900	9.41	12.91	14.94	77.6	72.3	1-6
0930	9.17	12.32	14.38	83.9	75.8	
1000	9.32	12.90	15.33	82.9	76.4	
1030	9.15	12.70	15.08	84.1	79.5	
1100	8.47	13.75	15.23	81.1	76.2	
1130	10.21	13.62	14.95	83.8	77.9	
1200	11.06	13.46	14.42	84.0	79.0	1-7
1230	11.74	13.35	13.98	85.6	80.5	
1300	12.12	13.60	14.22	84.9	79.2	
1330	11.70	13.80	14.45	84.1	79.5	
1400	12.66	-	14.04	83.6	79.9	1-8
1430	12.51	13.74	13.75	85.3	82.6	
1500	10.97	13.47	13.58	86.6	85.9	
1530	11.58	13.67	13.70	86.2	85.3	
1600	11.30	13.03	13.38	86.1	83.9	
1630	10.75	12.87	14.25	85.9	79.7	1-9
1700	9.30	12.96	14.66	88.0	81.2	
1730	9.85	13.63	14.50	90.5	85.2	
1800	13.61	13.14	14.33	89.1	85.6	
1830	13.55	14.08	14.40	87.6	85.0	
1900	-	14.07	14.30	87.3	84.9	1-10
2000	12.85	13.42	13.53	89.6	88.1	1-11
2030	12.66	12.49	12.59	89.7	87.7	
2100	13.18	13.49	13.65	88.8	86.4	
2130	13.26	13.69	13.76	90.3	89.1	
2200	12.93	14.16	14.18	88.0	85.6	
2230	15.10	14.59	14.55	87.3	86.4	
2300	17.40	15.50	15.35	83.2	81.9	
2330	17.44	15.28	15.26	85.9	85.2	
8/2						
0000	16.24	15.52	15.52	85.3	83.7	
0030	12.98	15.68	15.81	85.8	85.2	

Time	T_s	T_1	T_2	H_1	H_2	
0100	14.80	16.04	16.02	86.2	85.0	
0130	13.78	16.26	16.21	83.8	82.6	
0200	13.11	16.08	16.06	83.5	82.9	
0230	9.25	14.77	14.81	87.7	86.6	
0300	10.08	14.71	14.66	83.8	82.1	
0330	10.91	14.27	14.21	86.4	84.5	
0400	9.42	14.92	14.84	82.1	81.4	
0430	6.08	15.59	15.60	84.9	84.2	
0500	9.15	16.15	15.88	87.3	86.3	
0530	8.02	16.57	16.49	82.1	81.4	
0600	7.75	16.66	16.58	81.6	80.7	
0630	7.24	16.36	16.40	83.9	83.6	
0700	8.73	15.74	15.76	88.2	88.2	
0730	9.33	15.86	15.80	88.2	88.4	
0800	10.28	16.14	16.09	86.3	86.2	
0830	10.02	16.24	16.35	84.2	83.7	
0900	10.80	16.17	16.40	83.9	83.2	
0930	17.01	16.02	16.22	85.8	85.3	
1000	16.75	15.90	16.22	83.3	82.3	2-1
1030	15.65	15.97	15.88	84.2	82.0	
1100	15.76	15.83	15.84	86.7	84.9	
1130	15.30	15.67	15.69	87.7	85.9	
1200	13.33	15.57	15.95	87.6	84.3	
1230	11.95	13.78	14.36	87.7	83.8	
1300	12.09	13.45	14.09	87.0	83.1	
1330	10.48	13.82	14.52	88.6	86.7	2-2
1400	10.83	13.97	15.17	88.2	86.8	
1430	10.93	14.63	15.37	84.5	86.1	
1500	10.44	13.70	15.60	88.5	88.1	
1530	10.39	13.50	15.53	90.0	90.9	
1600	10.60	13.60	14.50	90.8	87.2	
1630	11.42	13.53	14.48	91.9	89.7	
1700	12.11	14.26	15.22	91.2	88.1	
1730	11.80	14.62	16.08	91.7	87.4	

Time	T_s	T_1	T_2	H_1	H_2	
1800	11.42	13.71	15.39	92.1	88.2	2-3
1830	-	-	-	-	-	
1900	10.64	13.28	13.87	93.1	92.2	
1930	10.86	12.62	13.44	94.0	93.9	2-4
2000	10.72	12.55	13.20	95.6	95.2	
2030	10.89	14.09	14.75	96.8	97.1	
2100	10.67	13.97	14.37	96.8	96.9	2-11
2130	14.12	14.20	14.39	96.6	96.4	
2200	14.38	14.26	14.33	96.3	96.3	
2230	11.12	13.78	14.55	95.7	96.2	2-15
2300	9.96	13.09	14.09	96.2	95.4	
2330	10.31	12.49	14.45	96.6	95.6	2-21
8/3						
0000	9.73	13.10	14.69	97.1	95.1	3-1
0030	10.37	13.65	15.02	97.1	94.9	
0100	11.18	13.64	15.06	97.0	93.0	
0130	10.47	13.41	14.69	96.9	93.7	3-2
0200	10.52	13.43	14.88	96.9	93.2	3-3
0230	12.20	13.59	14.48	97.1	95.8	3-4
0300	10.76	13.54	15.03	96.8	96.4	3-5
0330	13.36	14.39	14.80	96.3	93.5	
0400	12.73	14.24	14.64	95.0	93.7	
0430	14.09	14.41	14.86	94.1	91.0	
0500	12.54	14.03	14.62	93.8	91.9	
0530	12.26	13.63	13.58	95.1	94.0	
0600	11.67	13.40	14.23	95.1	91.9	
0630	13.72	14.38	15.28	94.1	90.4	
0700	14.54	14.45	14.85	92.7	89.9	
0730	11.15	13.59	14.12	90.8	88.9	
0800	9.56	13.26	14.56	90.9	87.8	3-6
0830	10.41	12.80	13.37	92.5	92.6	
0900	10.13	11.56	11.70	92.4	92.1	
0930	10.56	11.58	11.90	95.2	93.9	
1000	11.20	12.49	13.34	96.0	94.2	
1030	10.82	13.10	14.09	95.0	92.1	
1100	11.99	13.31	14.01	95.4	92.7	

Time	T_s	T_1	T_2	H_1	H_2	
1130	13.59	13.78	14.03	96.2	95.1	3-8
1200	13.35	14.04	14.45	96.1	93.9	3-9
1230	13.44	13.90	14.18	95.2	94.2	3-10
1300	13.83	14.12	14.53	94.6	93.0	
1330	12.25	14.12	14.53	94.6	93.0	
1400	14.31	14.42	14.85	93.5	91.4	3-11
1430	14.35	14.54	14.98	92.0	89.8	3-12
1500	14.08	14.31	14.72	91.5	90.5	
1530	11.82	13.53	13.96	93.1	92.8	3-13
1600	12.84	13.50	13.80	95.2	94.7	
1630	13.30	13.53	13.72	96.0	95.3	
1700	11.40	12.96	13.50	95.9	94.4	3-19
1730	11.23	13.41	13.85	96.4	95.0	3-20
1800	11.74	13.60	13.91	96.8	95.0	3-21
1830	11.92	13.64	13.93	96.9	95.1	
1900	12.11	13.74	13.97	96.7	95.7	
1930	12.74	13.76	13.95	96.8	95.8	3-22
2000	11.20	14.03	14.33	96.5	95.7	3-23
2030	12.96	14.43	14.67	96.9	95.7	3-24
2100	13.67	14.65	14.86	96.9	94.9	3-25
2130	12.50	14.76	14.96	96.4	94.4	
2200	14.04	14.88	15.09	96.6	94.1	3-26
2230	14.73	15.03	15.06	96.1	95.6	3-27
2300	16.14	15.26	15.22	96.2	96.0	3-28
2330	15.91	15.42	15.39	96.0	96.2	
8/4						
0000	16.06	15.43	15.43	95.9	95.7	3-29
0030	15.29	15.54	15.51	95.7	95.8	
0100	16.19	15.68	15.65	96.1	96.1	4-1
0130	16.76	15.78	15.80	96.2	95.8	4-2
0200	16.88	15.95	15.90	96.1	96.3	
0230	16.68	16.07	16.02	95.9	95.8	4-3
0300	16.60	16.10	16.04	95.5	95.8	
0330	15.88	15.98	15.93	95.3	95.7	
0400	14.96	15.78	15.88	95.0	95.4	

Time	T_s	T_1	T_2	H_1	H_2	
0430	14.91	15.55	15.61	95.2	95.4	
0500	15.31	15.21	15.41	95.1	95.7	
0530	14.12	14.99	15.15	95.6	95.8	
0600	15.73	15.59	15.61	96.0	96.0	4-4
0630	14.05	15.42	15.51	96.0	96.0	
0700	11.47	13.25	14.15	94.7	93.9	4-5
0730	10.71	12.24	13.17	95.4	94.2	4-7
0800	10.90	12.63	13.22	96.4	95.3	4-8
0830	12.36	12.93	13.45	96.8	94.2	
0900	12.61	12.95	13.25	96.8	94.0	4-13
0930	10.20	12.69	13.30	97.0	93.9	
1000	9.33	12.78	13.55	97.0	93.0	4-14
1030	9.77	13.22	13.16	96.0	95.8	
1100	11.52	12.86	13.37	96.2	95.3	
1130	12.23	13.36	13.68	96.4	94.6	4-15
1200	12.26	13.80	13.93	96.2	94.6	
1230	12.22	13.37	13.70	96.4	93.2	
1300	12.35	13.00	13.36	96.4	92.8	4-16
1330	10.31	12.47	13.05	96.7	92.3	
1400	10.67	12.43	13.00	97.6	92.7	4-17
1430	-	13.37	13.71	97.4	94.2	4-18
1500	-	15.12	15.20	97.2	94.9	
1530	-	15.31	15.31	96.4	95.1	
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8/5						
0830	10.45	13.13	14.11	96.7	92.2	
0900	11.25	13.01	13.01	96.5	93.2	
0930	10.00	13.00	14.70	95.8	89.8	
1000	10.50	13.02	13.03	96.3	89.9	5-1
1030	10.54	14.51	14.41	96.8	89.9	5-2
1100	13.01	14.44	15.47	95.4	87.7	
1130	13.45	15.21	15.51	94.0	88.1	5-3
1200	14.00	15.43	15.40	93.1	89.9	5-4
1230	13.42	15.41	15.45	91.6	91.1	
1300	14.20	15.41	15.44	91.7	91.8	

Time	T_s	T_1	T_2	H_1	H_2	
1330	14.55	14.13	14.25	90.2	90.5	
1400	12.50	-	-	-	-	
1430	11.20	-	-	-	-	
1500	11.45	15.55	14.01	85.2	82.8	
1530	11.47	14.75	15.44	88.7	88.9	
1600	12.42	15.24	15.57	90.9	90.2	5-6
1630	12.54	15.55	15.52	86.8	87.1	
1700	11.45	15.50	-	88.3	87.3	5-7
1730	12.57	15.17	15.05	87.5	88.4	5-8
1800	13.03	14.44	15.04	89.5	90.2	
1830	10.32	15.04	15.05	90.0	90.2	5-9
1900	16.30	16.17	16.12	89.0	89.3	
1930	16.02	16.20	16.20	89.8	89.9	
2000	15.67	16.29	16.26	89.9	90.6	5-10
2030	16.87	16.62	16.56	90.5	91.3	
2100	16.49	16.86	16.89	89.7	90.3	5-11
2130	16.19	16.83	16.83	90.1	90.8	
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8/6						
0030	15.98	15.88	15.96	95.2	94.9	6-1
0100	16.06	15.85	15.98	95.4	94.9	
0130	16.00	16.00	16.07	96.0	95.3	6-4
0200	15.97	15.92	16.01	95.9	95.2	6-5
0230	15.63	15.64	15.81	96.2	96.8	
0300	15.46	15.45	15.69	96.5	97.4	6-9
0330	15.94	15.88	15.87	96.3	97.0	6-10
0400	15.80	15.89	15.94	96.3	96.7	
0430	15.90	15.60	15.72	96.5	96.4	6-11
0500	15.37	15.63	15.77	96.4	96.4	
0530	15.38	15.52	15.65	96.6	96.6	6-12
0600	14.77	15.60	15.70	96.6	96.9	
0630	14.68	14.69	15.57	96.7	96.6	6-13
0700	14.64	15.73	15.94	96.6	96.9	6-14
0730	16.00	16.16	16.28	96.6	96.9	6-15
0800	16.36	16.56	16.57	96.4	96.5	

Time	T_s	T_1	T_2	H_1	H_2	
0830	16.71	16.83	16.85	96.2	95.7	6-16
0900	16.48	16.74	16.83	94.7	96.1	6-18
0930	16.76	16.75	16.86	95.0	95.4	
1000	17.08	17.09	17.13	95.2	94.9	6-19
1030	16.20	16.92	16.83	93.5	92.6	6-22
1100	16.60	16.97	16.94	90.8	90.9	
1130	16.07	15.51	15.88	89.0	89.9	
1200	14.07	14.79	15.27	89.2	90.6	6-23
1230	16.76	16.60	16.83	90.6	90.7	
1300	16.29	17.33	17.63	87.4	87.6	
1330	16.26	17.01	17.19	88.0	88.1	
1400	17.00	17.47	17.73	88.6	87.4	
1430	16.70	17.22	17.92	87.9	96.9	
1500	17.45	17.39	17.80	87.0	85.6	
1530	16.89	18.81	19.41	85.1	82.9	
1600	17.33	17.91	18.51	86.4	85.1	
1630	16.02	17.24	17.55	88.7	87.9	6-24
1700	15.26	17.53	17.44	89.5	89.4	
1730	15.72	17.05	17.03	90.0	90.3	6-25
1800	15.73	16.79	16.98	90.7	92.0	
1830	14.79	16.37	16.40	90.7	92.2	
1900	15.19	16.50	16.69	92.2	93.1	6-26
1930	14.62	15.85	16.41	92.9	94.1	6-28
2000	15.51	15.84	15.95	93.6	94.6	
2030	14.69	15.59	15.70	93.1	94.1	6-29
2100	14.12	15.27	15.41	93.5	94.5	
2130	14.93	15.33	15.36	92.2	94.1	
2200	15.90	15.67	15.64	93.9	94.8	6-30
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8/7						
0100	16.80	16.84	16.83	93.9	95.1	
0130	17.12	17.13	17.18	91.5	92.2	
0200	17.24	17.08	17.07	90.8	91.3	

Time	T_s	T_1	T_2	H_1	H_2	
0230	16.90	17.47	17.43	92.7	94.0	
0300	17.06	17.20	17.13	94.4	95.8	
0330	15.55	16.90	16.89	95.3	96.3	7-1
0400	15.65	16.32	16.47	95.7	96.9	7-2
0430	16.06	16.16	16.15	96.1	97.1	7-3
0500	16.24	16.11	16.08	96.2	97.1	7-4
0530	16.49	15.81	15.79	96.4	97.2	7-5
0600	16.47	15.93	15.91	96.5	97.3	
0630	16.55	16.16	16.15	96.5	97.4	
0700	16.26	16.34	16.35	96.6	97.3	7-10
0730	16.22	16.49	16.57	96.6	96.4	7-11
0800	16.32	16.52	16.73	96.5	96.4	7-12
0830	16.40	16.56	16.55	96.9	95.9	7-13
0900	16.62	16.67	16.76	95.8	94.8	
0930	16.55	16.82	16.79	95.1	94.9	7-14
1000	16.39	16.47	16.33	94.3	94.1	7-15
1030	16.20	16.44	16.21	94.1	96.3	
1100	15.66	16.24	16.01	94.1	95.6	7-16
1130	16.06	16.44	16.25	94.1	94.7	
1200	-	-	-	-	-	
1230	15.85	16.23	16.04	92.9	94.8	
1300	16.25	16.29	16.07	93.7	95.1	7-17
1330	16.24	16.33	16.34	92.7	94.5	
1430	-	16.16	16.02	93.2	95.0	
1500	-	16.08	15.92	93.8	95.7	
1530	16.16	16.08	16.08	93.4	95.7	
1600	16.24	15.92	15.76	93.9	96.3	7-18
1630	16.16	-	15.80	94.2	96.7	
1700	15.90	15.76	15.66	94.8	97.2	
1730	15.76	15.76	15.52	95.3	97.6	7-19
1800	15.32	15.18	15.64	96.4	98.0	7-22
1830	14.96	14.90	14.24	96.8	98.4	7-23
1900	14.78	14.76	14.52	97.1	98.3	
1930	14.86	14.84	14.98	97.4	98.0	
2000	14.90	14.90	-	97.4	98.0	

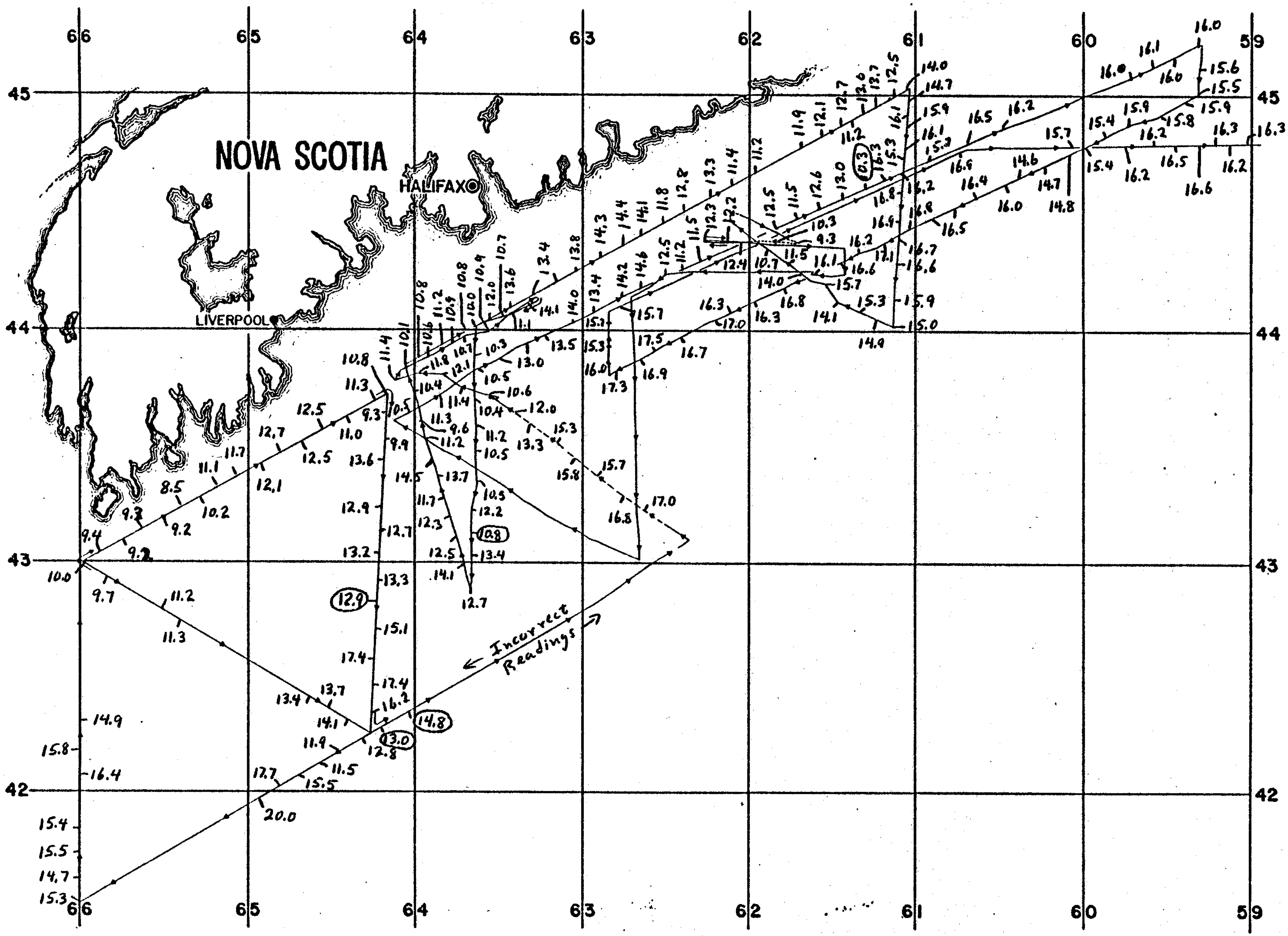
Time	T_s	T_1	T_2	H_1	H_2	
2030	15.06	15.06	15.06	97.4	98.2	7-28
2100	-	15.22	15.12	97.4	98.0	
2130	15.30	15.28	-	97.4	98.0	
2200	15.36	15.32	15.32	97.3	98.0	7-29
2230	15.34	15.34	15.22	97.3	98.0	7-31
2300	15.30	15.26	-	97.3	97.9	7-32
2330	15.28	-	15.14	96.8	97.7	
8/8						
0000	15.24	15.22	-			7-36
0030	14.96	15.04	14.48			
0100	14.40	14.74	15.08			
0130	14.46	15.32	15.34			
0200	-	15.28	15.34			8-6
0230	14.84	15.44	15.50			8-7
0300	-	15.62	15.60			8-8
0330	16.28	16.28	15.80			
0400	-	16.00	15.96			8-9
0430	16.40	16.42	15.96			8-10
0500	16.30	15.98	15.96	97.8	98.5	
0530	16.08	15.96	15.94	98.1	98.7	
0600	16.10	16.04	16.06	98.2	98.8	8-15
0630	16.68	16.02	16.06	98.3	98.9	8-16
0700	16.10	15.80	15.88	98.3	99.0	8-17
0730	16.06	16.04	15.50	98.3	98.8	8-18
0800	16.08	15.50	15.55	98.2	98.7	8-20
0830	-	14.98	15.30	98.0	98.0	
0900	14.08	14.76	6.76	98.0	97.5	8-24
0930	-	14.70	15.16	98.0	96.0	8-25
1000	14.78	14.32	14.32	97.7	95.2	8-26
1030	-	14.30	14.52	97.3	95.7	
1100	14.92	14.40	14.62	96.8	95.6	8-28
1130	15.02	14.28	14.50	96.4	95.8	
1200	-	14.44	14.60	95.1	93.7	
1230	15.14	14.58	14.78	90.0	89.0	8-29
1300	14.96	15.26	14.90	82.8	80.7	

Time	T_s	T_1	T_2	H_1	H_2	
1330	15.02	15.38	15.16	82.6	80.5	
1400	-	14.90	14.60	83.9	82.3	8-30
1430	15.04	14.84	14.84	86.7	84.4	
1500	14.72	14.82	14.62	87.7	86.9	8-31
1530	14.62	14.26	14.10	92.8	93.8	8-32
1600	15.28	14.48	14.34	93.5	94.0	8-34
1630	-	14.60	14.56	92.5	92.7	
1700	15.12	14.70	14.60	91.8	92.3	8-35
1730	15.68	14.60	14.48	92.7	94.5	
1800	15.48	14.56	14.60	93.8	95.2	
1830	15.40	14.44	14.46	93.8	95.3	
1900	15.48	14.16	14.16	96.0	97.1	8-36
1930	15.28	14.12	14.08	96.7	97.9	8-38
2000	15.04	15.04	14.08	97.4	98.2	8-40
2030	14.82	13.82	13.74	97.3	97.9	8-41
2100	15.08	14.02	13.88	96.5	97.5	
2130	15.10	14.18	14.06	92.4	94.0	
2200	14.78	14.08	14.08	92.4	94.3	8-42
2230	15.20	13.52	13.48	94.6	96.0	
2300	15.24	13.68	13.64	96.7	97.5	8-48
2330	15.30	14.14	14.10	97.2	98.0	
8/9						
0000	15.28	15.28	14.48	97.1	98.2	8-49
0030	-	14.70	14.64	97.3	98.1	
0100	15.22	14.80	14.74	97.4	98.2	9-5
0130	-	15.08	15.02	97.2	97.8	9-6
0200	15.94	15.34	15.28	97.1	98.1	9-7
0230	16.00	15.54	15.50	97.2	98.2	
0300	16.14	15.74	15.68	96.9	97.8	9-11
0330	15.90	15.88	15.84	97.3	97.8	9-12
0400	16.16	16.00	15.96	96.9	97.6	9-13
0430	-	15.70	15.68	97.2	97.7	9-14
0500	15.92	15.64	15.62	97.0	97.6	9-15
0530	15.84	15.84	15.28	96.9	97.8	9-16
0600	16.08	14.92	14.90	96.8	97.5	9-17

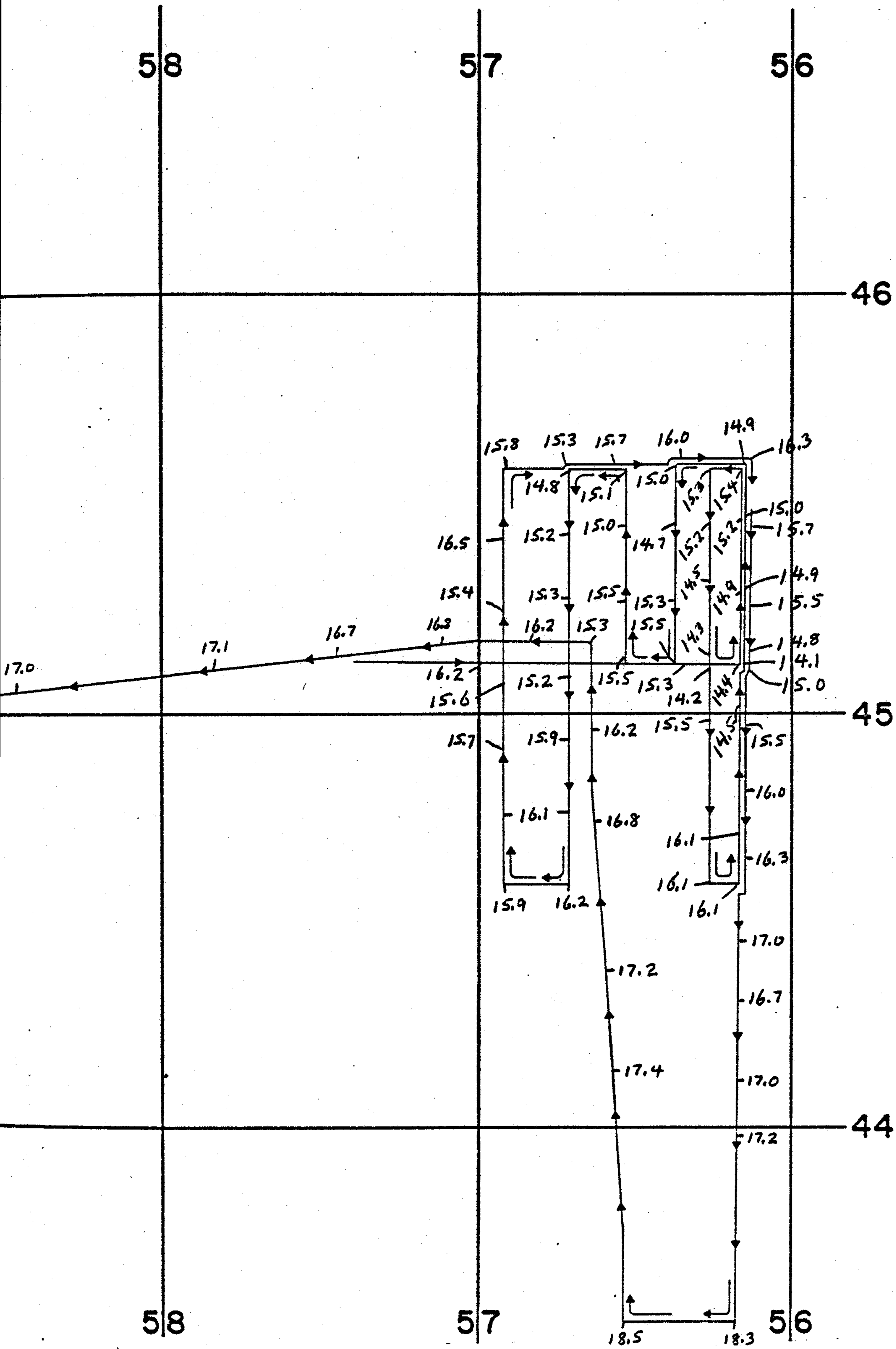
Time	T_s	T_1	T_2	H_1	H_2	
0630	-	14.86	14.82	96.8	97.4	
0700	15.74	14.98	14.74	96.6	96.9	9-18
0730	15.32	14.76	14.68	96.3	96.8	
0800	15.60	15.60	14.54	96.3	97.0	9-19
0830	15.92	14.70	14.70	96.1	96.5	9-20
0900	-	14.78	14.68	95.4	95.6	
0930	-	14.72	14.68	95.2	95.9	9-21
1000	16.46	14.86	14.84	94.7	95.0	9-22
1030	16.44	15.24	7.26	92.0	92.7	
1100	15.80	15.16	14.96	90.4	91.0	9-23
1130	15.90	15.62	15.60	88.7	88.0	
1200	15.28	16.08	15.82	87.4	87.6	9-24
1230	15.88	15.90	15.82	88.1	88.7	
1300	15.24	15.46	15.26	90.8	92.6	9-25
1330	15.88	15.26	15.16	92.4	94.5	9-26
1400	16.08	15.44	15.46	91.3	92.7	
1430	16.30	16.28	15.50	90.8	91.3	
1500	16.46	15.58	15.60	90.4	91.0	9-27
1530	15.64	15.66	-	90.2	91.0	
1600	15.68	15.72	15.50	91.2	91.4	
1630	15.74	16.04	15.74	90.9	89.2	
1700	15.48	15.64	-	91.8	91.9	9-28
1730	14.78	14.86	15.46	94.6	96.2	9-31
1800	14.96	15.04	-	96.0	97.0	
1830	15.18	15.18	15.92	96.3	97.2	9-35
1900	15.46	11.92	16.48	96.2	97.0	9-36
1930	15.72	-	16.76	96.2	96.9	
2000	16.06	16.00	16.74	94.9	95.5	
2030	16.32	16.26	-	94.0	95.0	
2100	16.30	16.26	17.28	94.1	95.4	9-37
2130	16.78	16.64	17.12	87.2	86.2	
2200	17.02	16.94	17.56	85.7	85.2	9-38
2230	16.90	-	16.90	85.4	84.5	
2300	16.74	16.72	17.36	89.7	90.0	
2330	16.78	16.70	-	91.4	92.8	

Time	T_s	T_1	T_2	H_1	H_2	
8/10						
0000	17.02	16.94	17.48	91.6	93.2	
0030	17.06	17.02	17.64	91.8	93.7	
0100	-	17.20	18.12	91.4	93.3	
0130	17.82	17.74	18.62	92.3	94.2	
0200	18.24	18.06	18.22	87.2	87.7	
0230	18.10	18.00	18.94	86.2	87.0	
0300	18.06	17.96	18.76	86.6	87.1	
0330	18.20	18.12	-	89.1	89.9	
0400	18.26	18.18	18.22	88.0	89.2	
0430	18.18	18.08	16.92	89.0	90.2	
0500	18.38	18.28	-	87.9	89.1	
0530	18.40	18.32	19.26	87.8	89.0	
0600	19.00	18.52	18.98	87.1	87.6	
0630	18.28	18.28	18.76	87.4	87.8	
0700	17.84	17.96	18.94	88.1	88.6	10-1
0730	17.24	17.54	18.98	89.5	90.4	
0800	17.34	17.70	19.14	91.4	91.3	
0830	17.65	18.00	19.04	89.0	88.5	
⋮						
1100	17.40	17.36	14.10	85.7	85.1	
1130	17.32	17.00	17.18	84.8	84.4	
1200	-	16.82	16.74	88.4	89.4	
1230	17.06	16.76	16.52	88.6	90.7	
1300	17.22	16.66	16.38	89.0	91.7	
1330	17.08	16.38	16.18	89.2	91.8	10-2
1400	17.02	16.94	-	89.2	91.6	
1430	17.06	16.26	15.88	89.6	92.2	10-6
1500	-	16.68	15.96	93.2	91.2	
1530	16.08	16.94	17.24	87.7	90.6	
1600	16.24	16.26	17.76	84.7	88.5	
1630	16.70	15.32	17.12	85.9	89.7	
1700	15.32	16.24	15.40	91.5	91.7	10-7
1730	15.52	-	15.58	95.3	96.1	

Time	T_s	T_1	T_2	H_1	H_2	
1800	15.54	12.52	15.60	95.8	96.7	10-13
1830	-	16.24	16.20	95.8	96.5	
1900	16.16	16.80	16.78	93.8	94.5	10-16
1930	16.78	16.84	16.84	93.3	94.5	
2000	16.96	16.98	16.90	93.8	95.2	10-17
2030	16.74	16.74	17.18	93.5	95.0	
2100	16.92	17.46	17.42	93.8	95.3	10-18
2130	16.96	17.54	17.50	93.4	94.9	
2200	16.76	16.76	17.44	94.1	95.7	10-19
2230	-	17.26	17.24	94.9	96.1	10-20
2300	16.42	17.10	17.10	95.6	97.1	10-23
2330	16.94	17.02	17.02	96.0	96.9	10-24
8/11						
0000	16.72	16.72	16.70	96.3	97.2	11-1
0030	16.70	16.74	16.72	96.5	97.1	11-2
0100	16.70	16.78	16.90	96.4	97.5	
0130	16.80	16.88	16.86	96.5	97.3	11-7
0200	17.06	16.96	16.96	96.8	97.8	11-8
0230	-	16.96	16.94	96.9	97.8	11-9
0300	16.98	17.00	17.06	96.9	97.7	
0330	17.16	17.16	17.28			11-15
0400	17.18	17.46	17.56			11-16
0430	17.10	17.28	17.62			
0500	-	17.18	17.46			
0530	17.00	17.32	17.60			
0600	-	17.32	17.58			
0630	17.08	17.26	17.70			
0700	17.10	17.58	17.74			



Marine Fog Cruise, USNS Hayes, 1975
Figure 5. Sea Surface Temperature Data



Marine Fog Cruise, USNS Hayes, 1975

Figure 6. Sea Surface Temperature Data

2) Mean Temperature and Humidity

In Table 4 we have the recorded sea surface, bow station, and mast station temperatures, T_s, T_1, and T_2 respectively, and the humidities. The values in the table are listed at one half hour intervals but are available at approximately 2.5 min intervals for the whole cruise and more frequently for portions of the cruise. The dashes in the table show times when a malfunction occurred so that the data is not available. Note that the values listed for humidity have not been corrected with the sensor calibration presented above, they are the raw data.

The code to the right of the table shows those times when a turbulence record was taken.

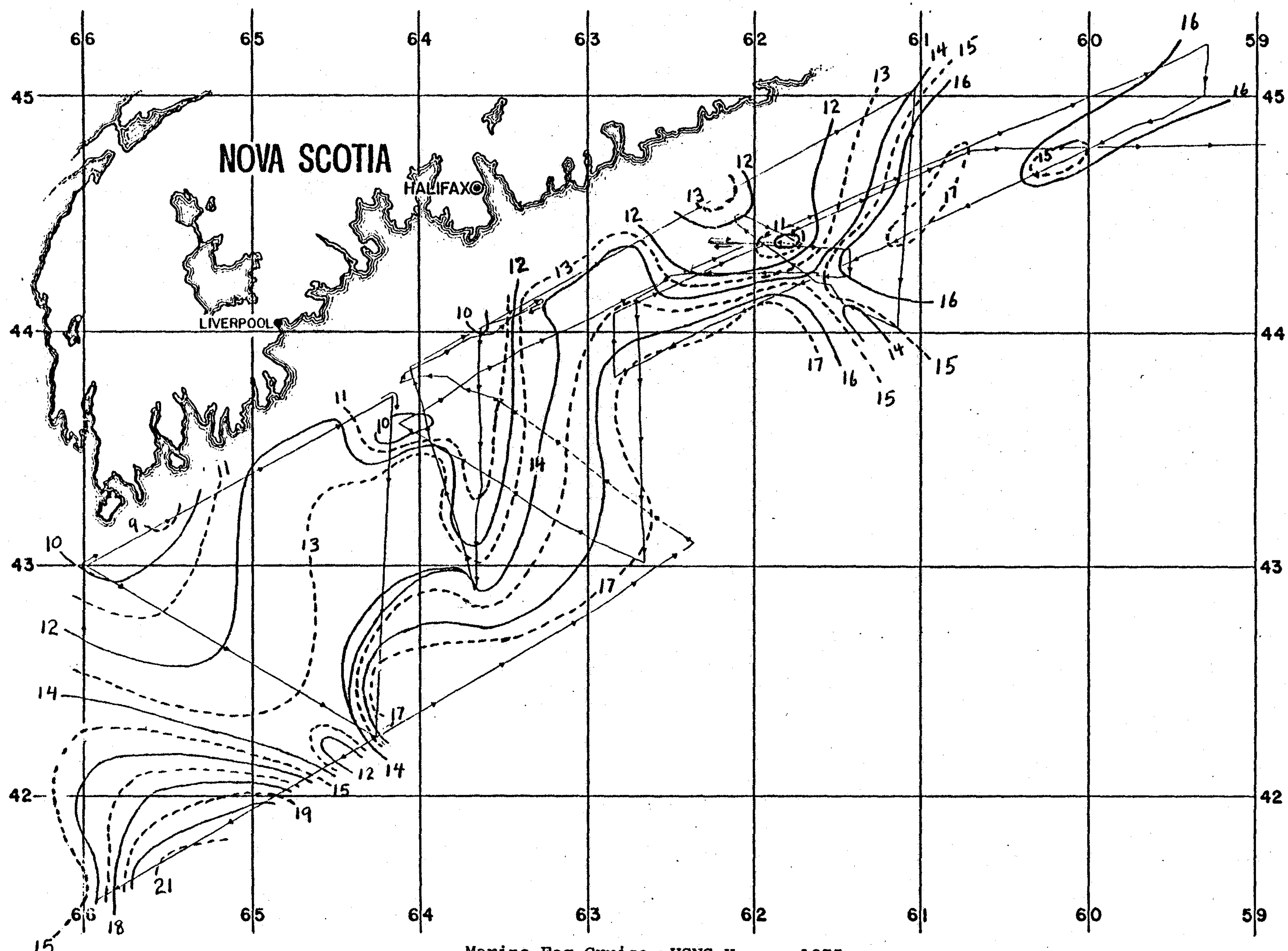
3) Sea Surface Temperature

The recorded sea surface temperature at one half hour intervals is shown on the navigation charts in Figures 5 and 6, Figure 5 showing the area immediately to the south of Nova Scotia and Figure 6 showing the Grand Banks area. From the data shown in Figure 5 we see that the temperatures recorded at the same location on different days are in quite good agreement. This was not the case in the Grand Banks area where it appears that the average sea surface temperature increased by about one degree during the time we were in the area.

Note that due to a malfunction in the equipment incorrect temperature readings were obtained for one full leg of the pattern sailed by the ship. (The readings were too low by several degrees.) The area where this occurred is shown on Figure 5.

4) Sea Surface Isotherms:

Sea surface isotherms are shown in Figures 7 and 8. These isotherms were constructed from the one half hour interval data presented in Figures 5 and 6.



Marine Fog Cruise, USNS Hayes, 1975
Figure 7, Sea Surface Temperature Data

G. Schacher

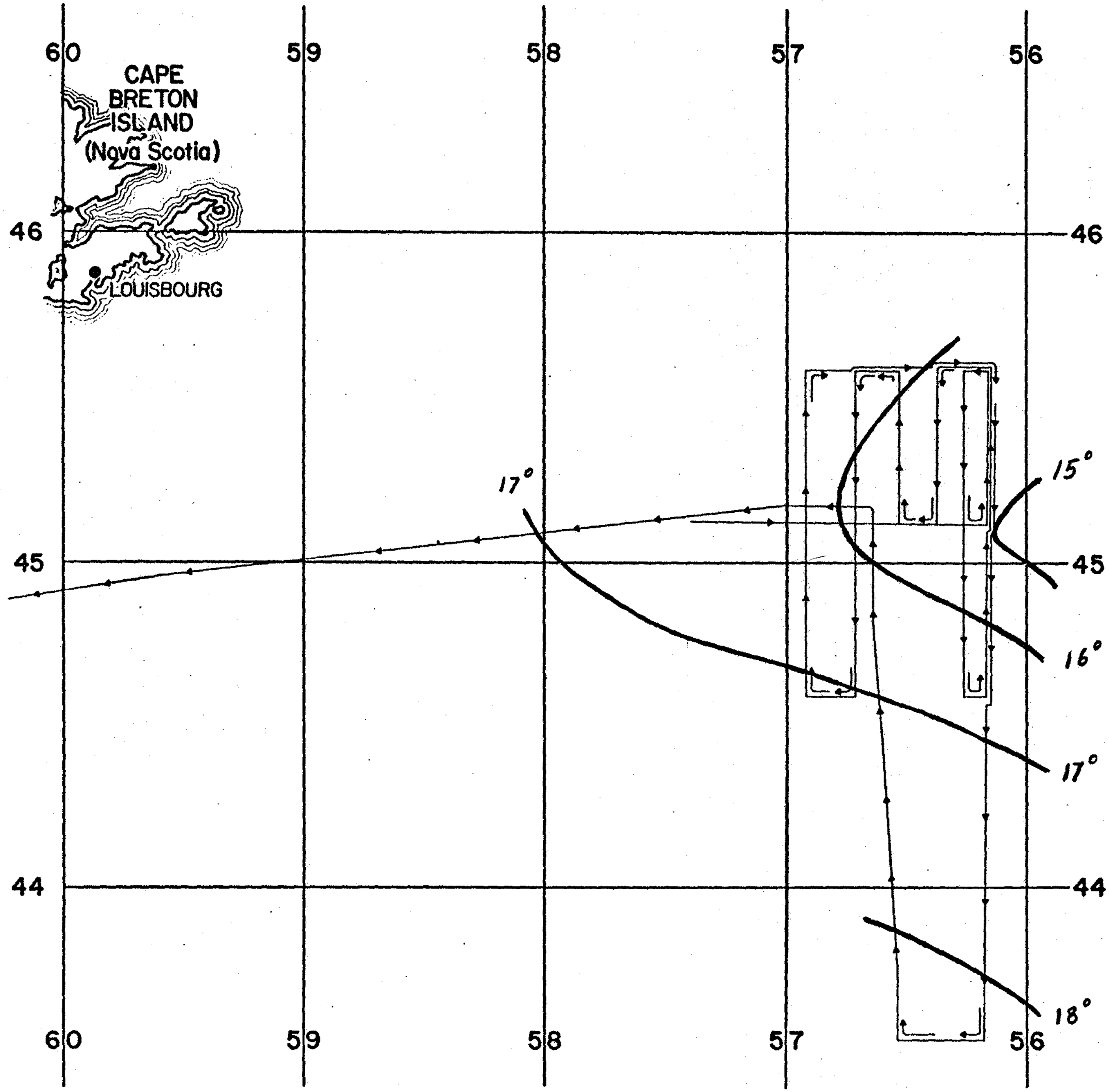


Figure 8. Sea Surface Temperature (^{o}C)

G. Schacher

In those figures note that five temperatures are circled; those temperatures were not used in constructing the isotherms. There are no isotherms crossing the leg of the ships cruise pattern where incorrect readings were obtained since we do not know the temperature at those positions. This means that we were not able to draw reliable isotherms for that area and have had to continue the lines above that leg rather than crossing it as several of the isotherms probably do. Due to the temperature variation with time in the Grand Banks area those isotherms plotted are the most reasonable averages for the data, and most closely represent the temperature for our last day in the area.

5) Approximate Fog Boundaries

Figure 9 shows the approximate location of the fog boundaries encountered in the areas immediately to the South of Nova Scotia. The Figure is not supposed to be an accurate representation of the fog boundaries that existed in that area at the time of the cruise since it only shows the positions at which the ship sailed across a boundary on a given day. This figure is included to show the fairly strong correspondence between the occurrence of areas of cold water and the presence of fog.

6) Times When Errors Occurred in Data:

There were times during the cruise when parts of the equipment were known to be either inoperative or operating incorrectly. These periods are listed for reference below.

7/29/75 The temperature values recorded may have been 0.6°C low all day due to loading of the quartz thermometer readout by the computer line. Line removed at 2000 and values correct after that time.

7/31/75 1100 Had to replace bow level wind cups

8/02/75 0900 Replace lamp in mast wind cups

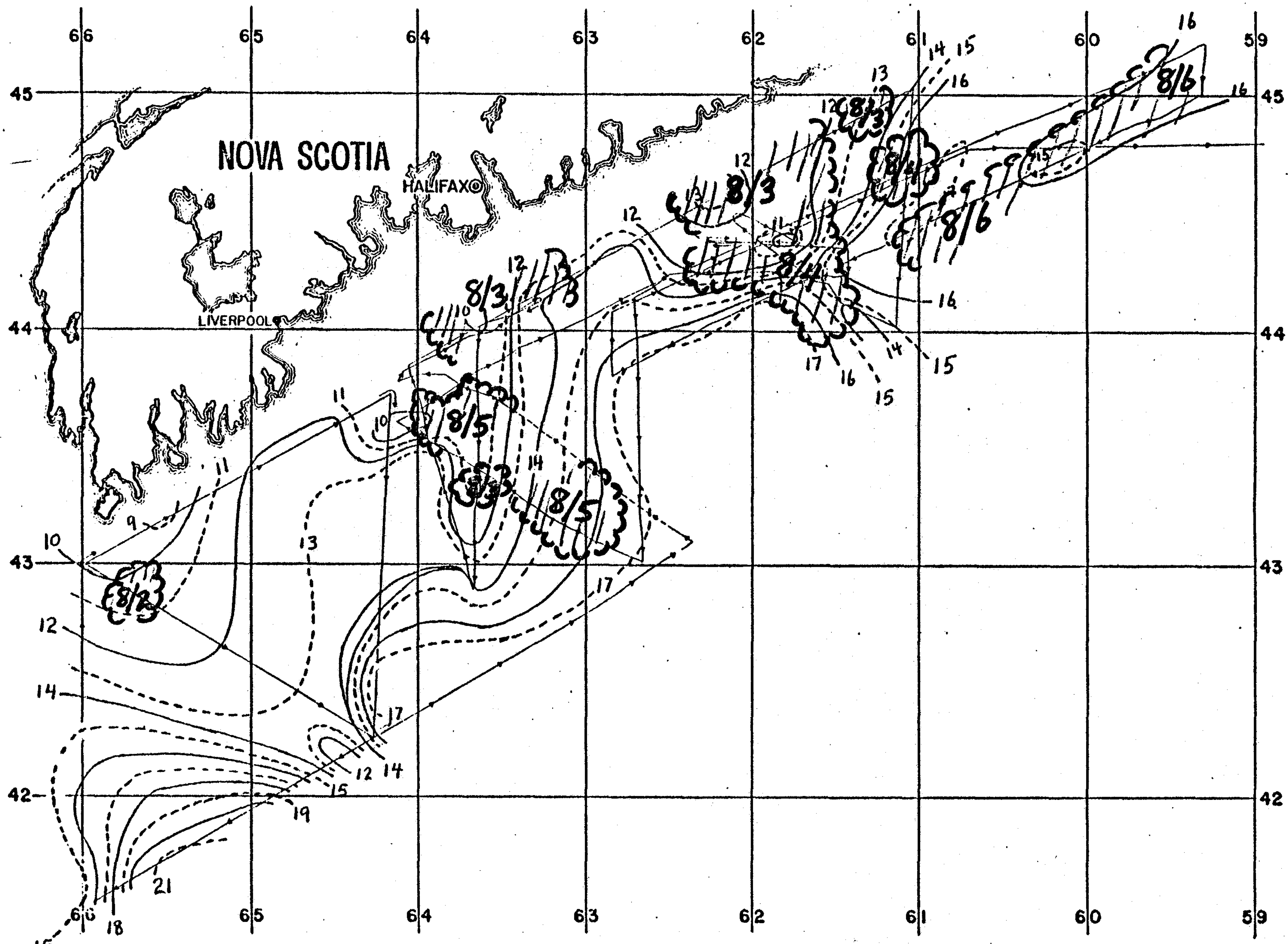


Figure 9. Marine Fog Cruise, USNS Hayes, 1975
Sea Surface Temperature Isotherms

8/03/75	1930	Mast wind cups giving intermittant readings
8/04/75	0100	Note that mast wind cups is out
	1400	Sea surface temperature unit out
		Both level wind cups still out
8/05/75	0830	Sea surface temperature repaired and working
	0830	Wind cups fixed on both levels

7) Horizontal Wind Velocity

Wind velocity data is not presented here since it is available on the NRL computer printout. (Copies of the data are available from Dr. Stuart Gathman, NRL.) The NPS-NAFI wind sensors recorded the only wind data available for the cruise since the shipboard wind register system ceased to function early in the cruise. The computer printout includes both the directly recorded relative wind and calculated true wind.

8) Time History Plots of Temperature

Plots of sea surface and air temperature at the two levels as functions of time are shown in Figures. The approximate ships headings are also shown on these figures as an aid to interpreting the temperature plots (e.g. one can easily identify times when the ship reversed course and sailed back through the same location.

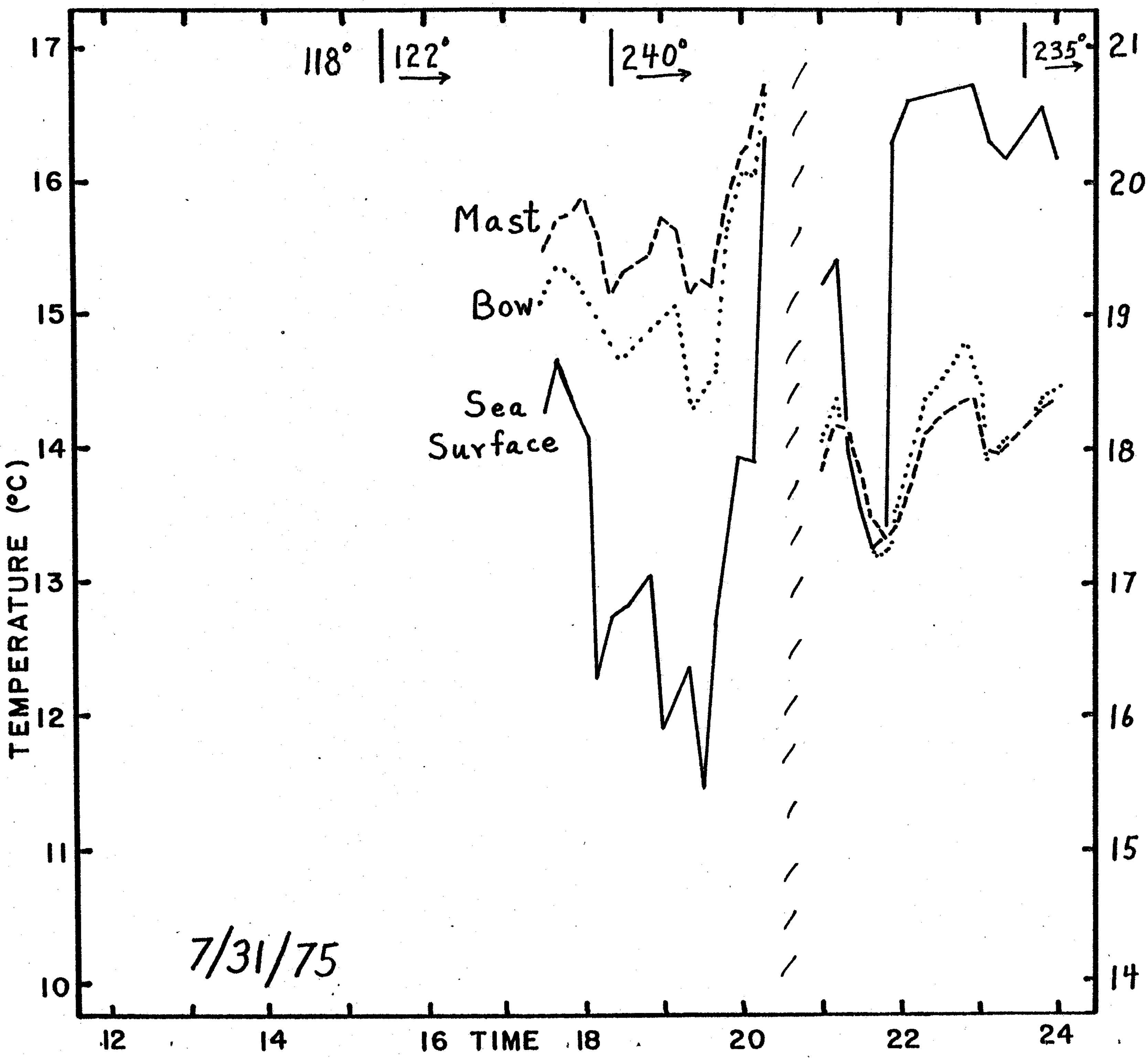


Figure 10. Recorded Temperatures vs time

Figure 10a.   Recorded Temperatures vs Time

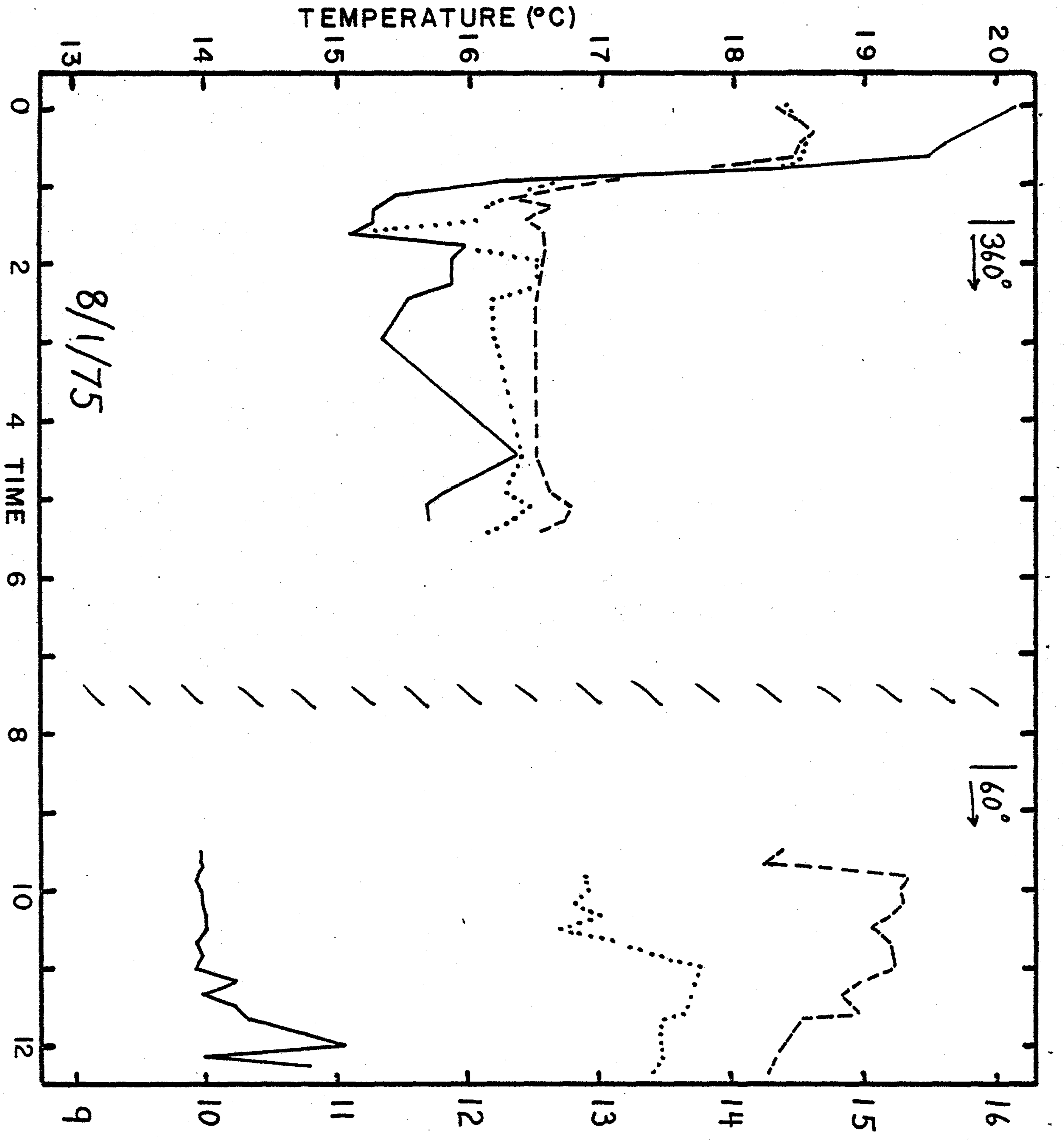


Figure 10b. Recorded Temperatures vs Time

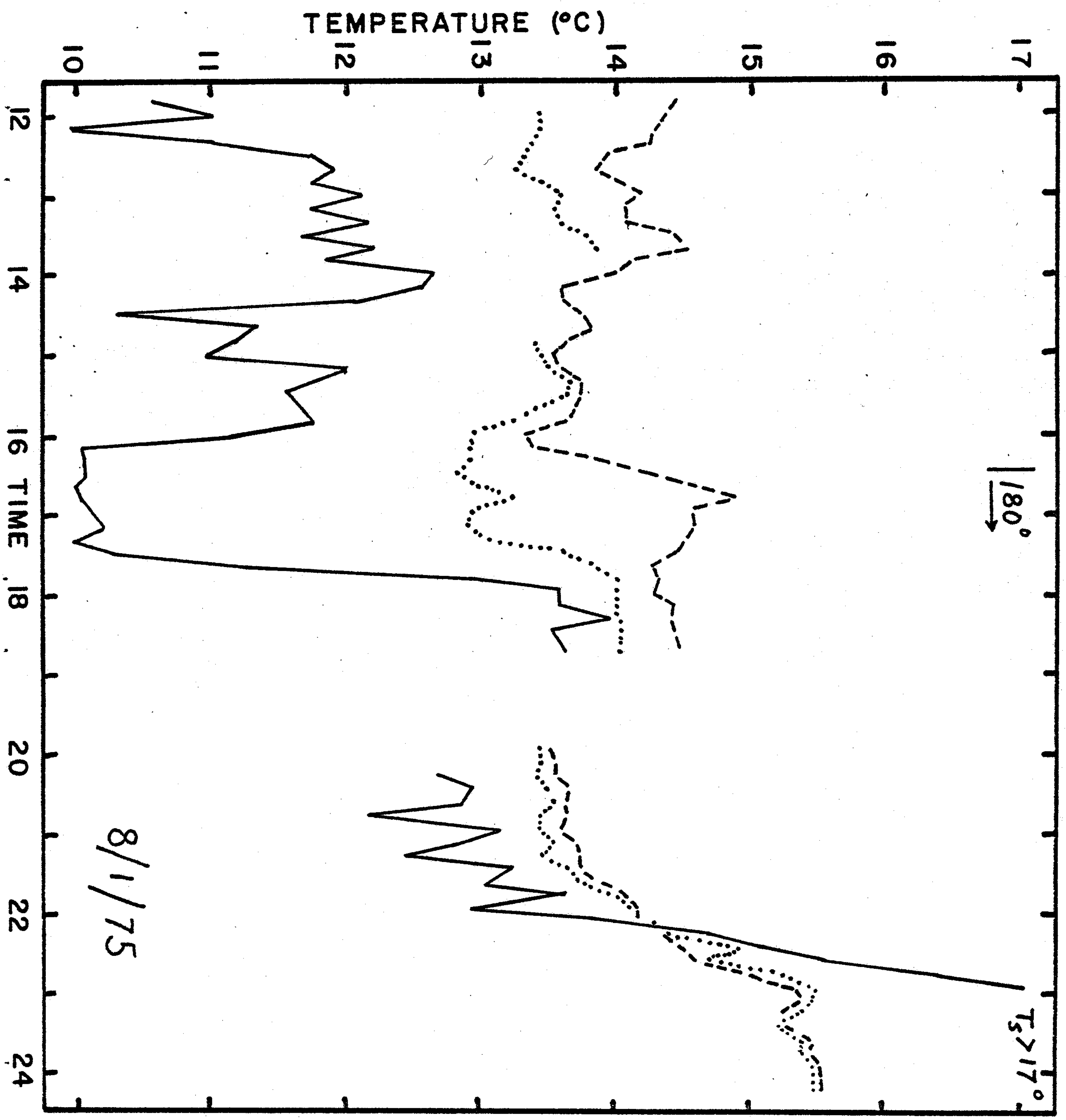


Figure 10c. Recorded Temperatures vs Time

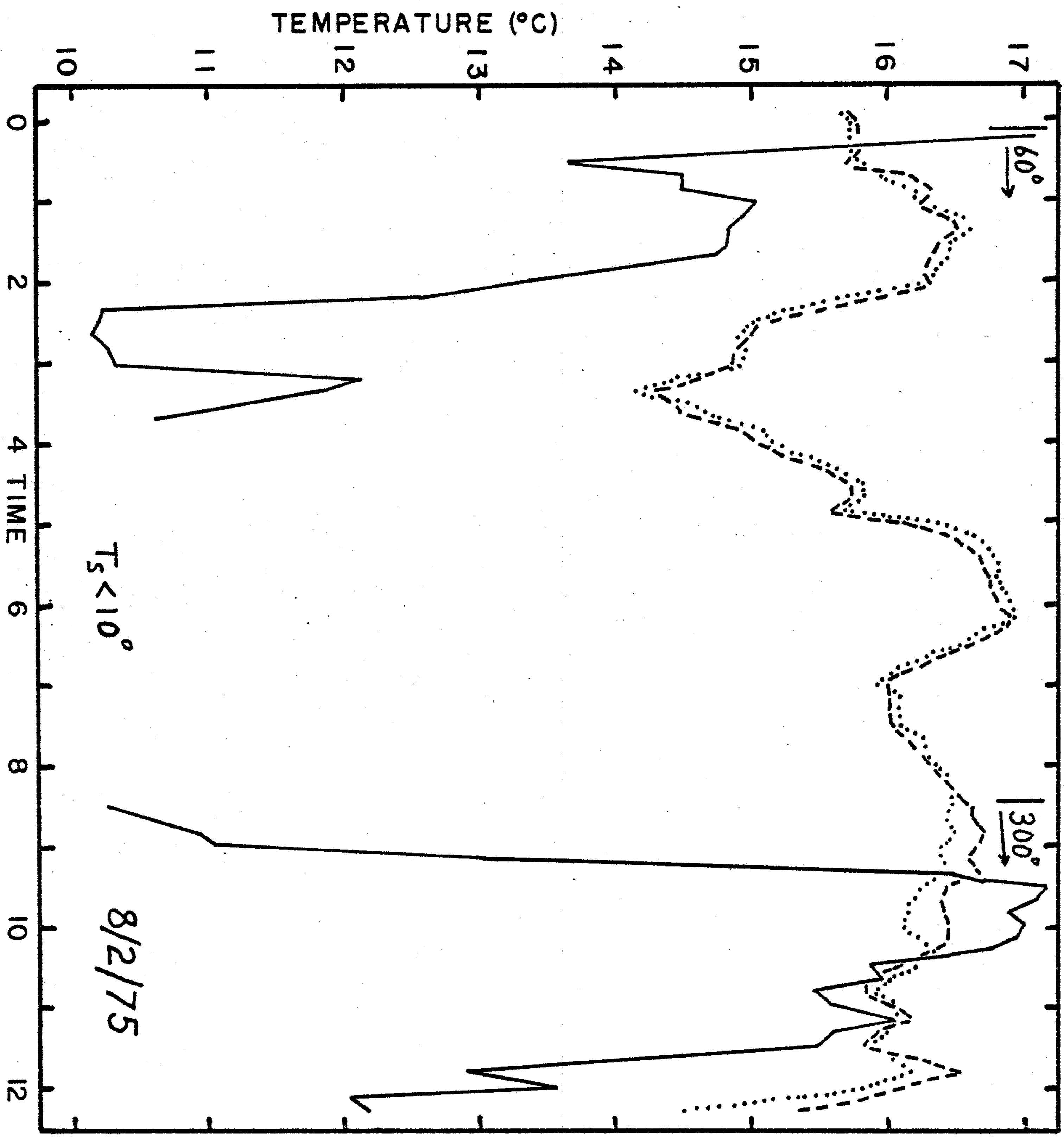


Figure 10d. Recorded Temperatures vs Time

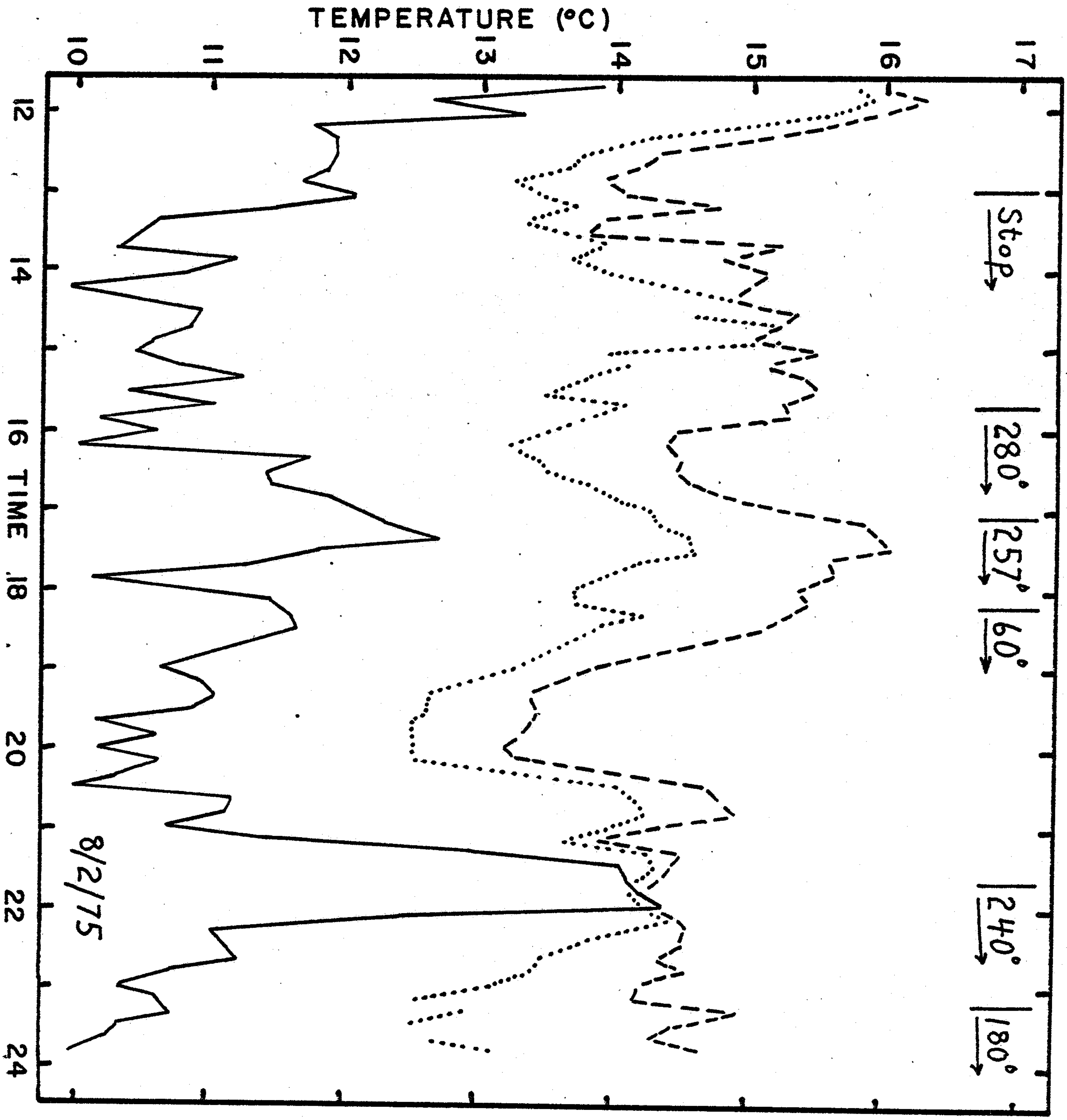


Figure 10e. Recorded Temperatures vs Time

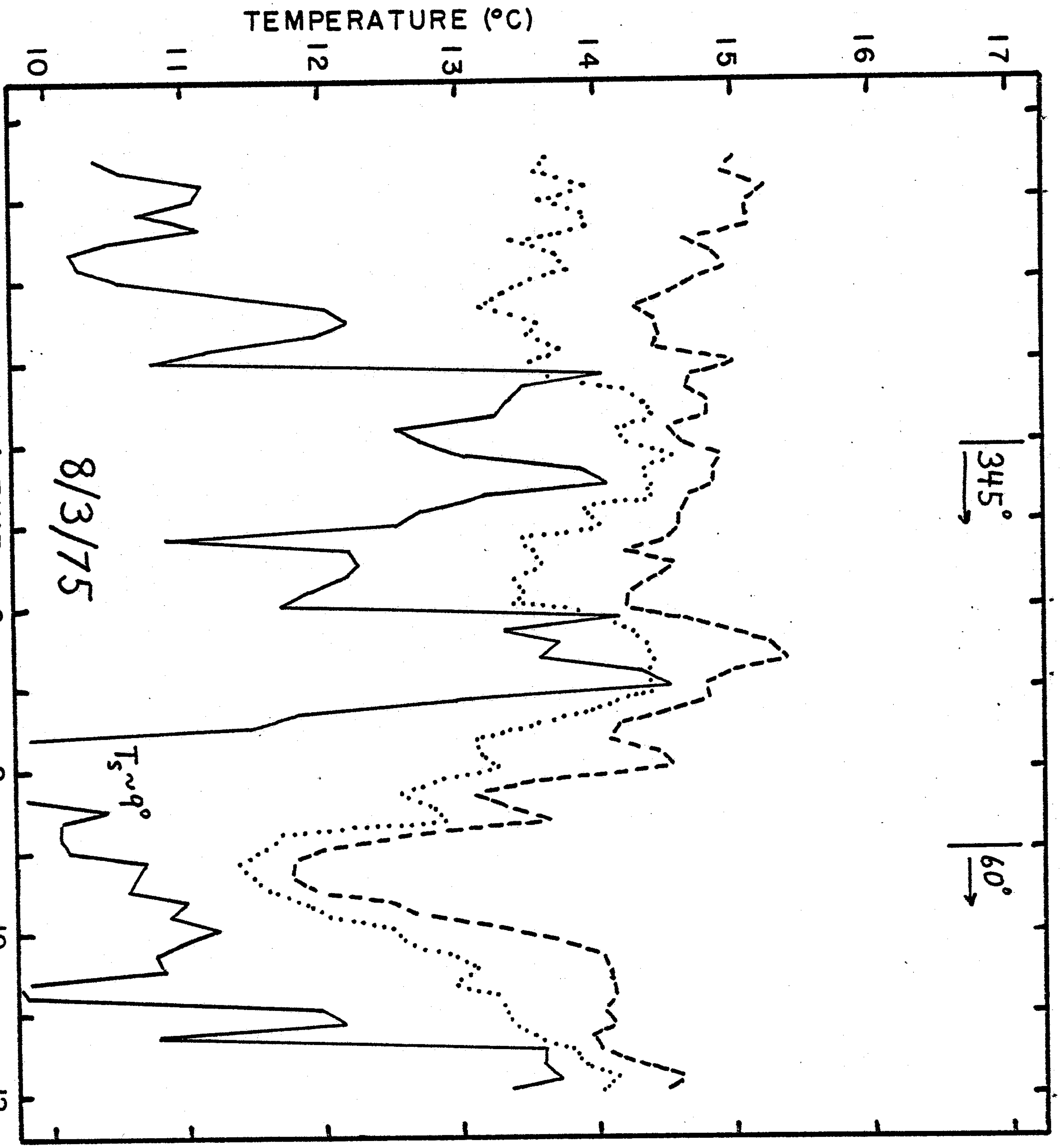


Figure 10f. Recorded Temperatures vs Time

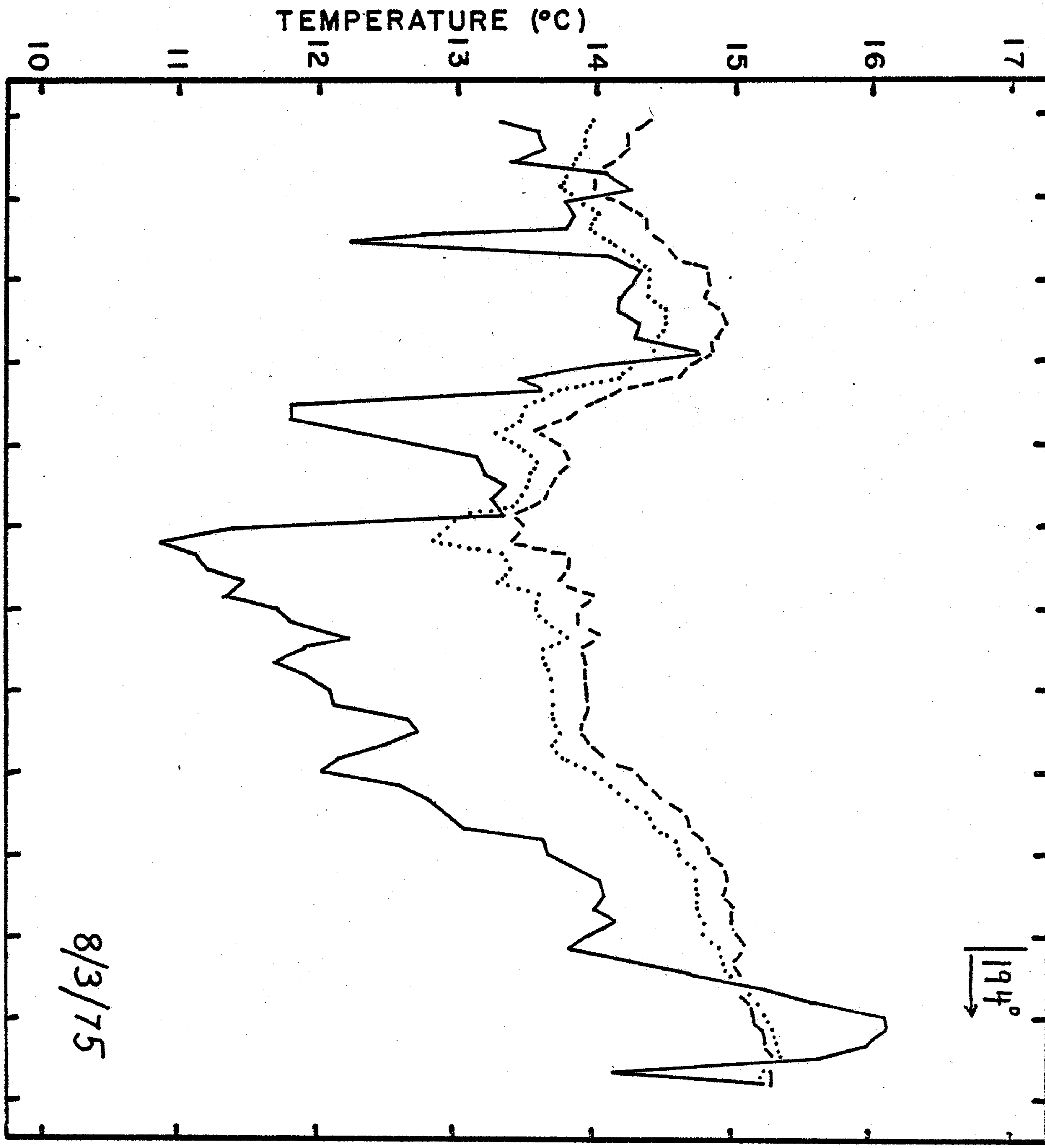


Figure 10g. Recorded Temperatures vs Time

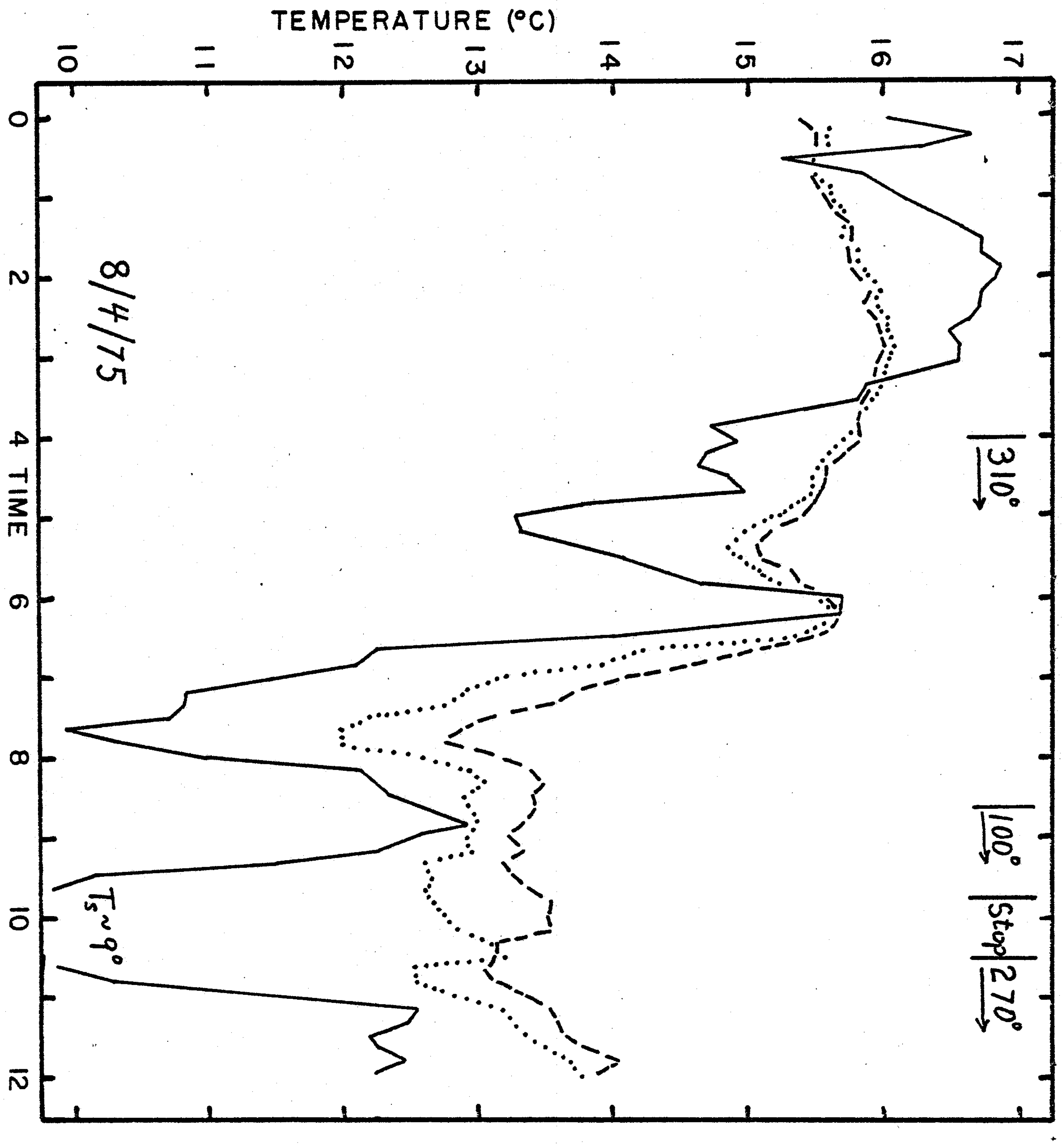


Figure 10h. Recorded Temperatures vs Time

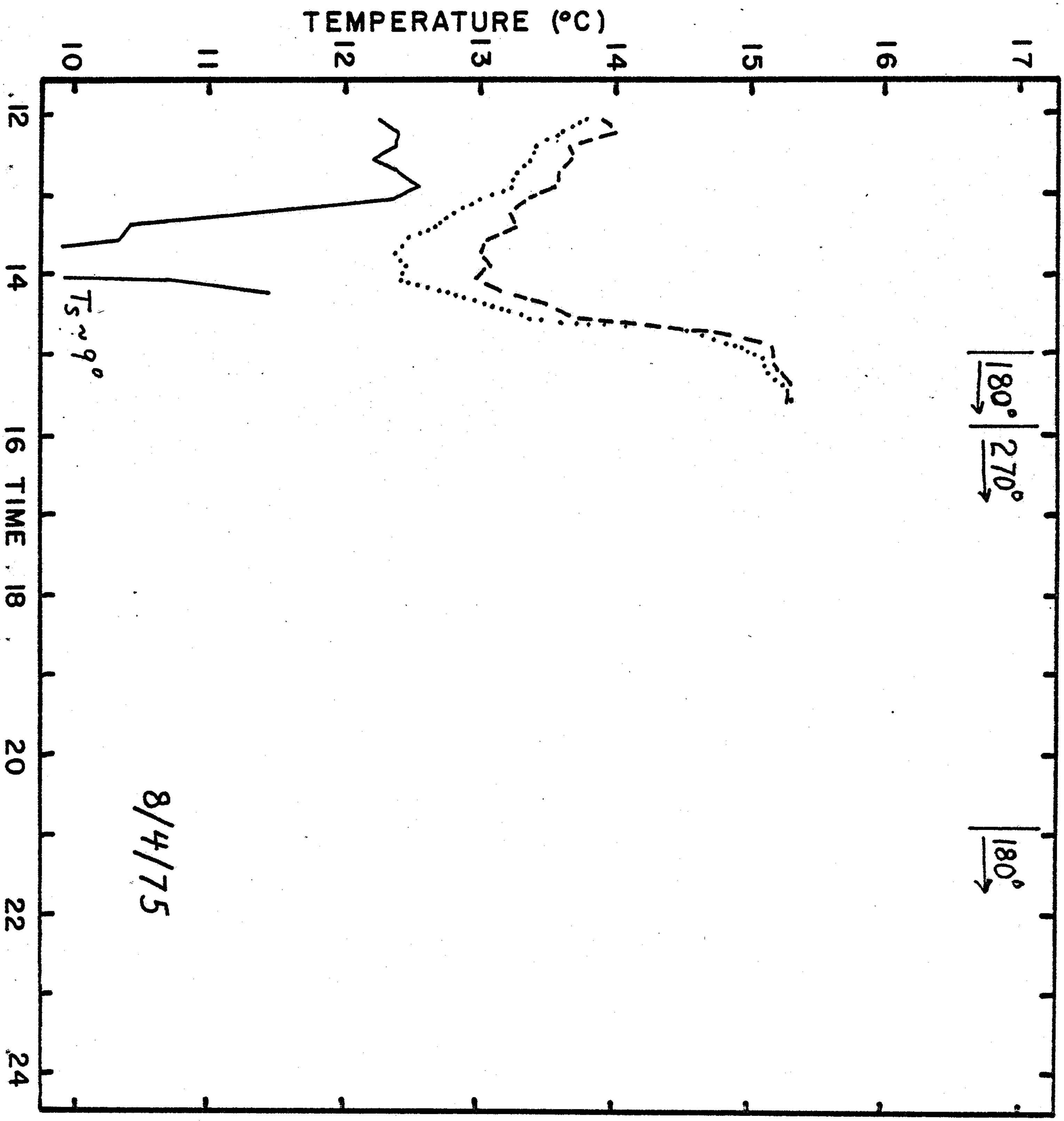


Figure 10i. Recorded Temperatures vs Time

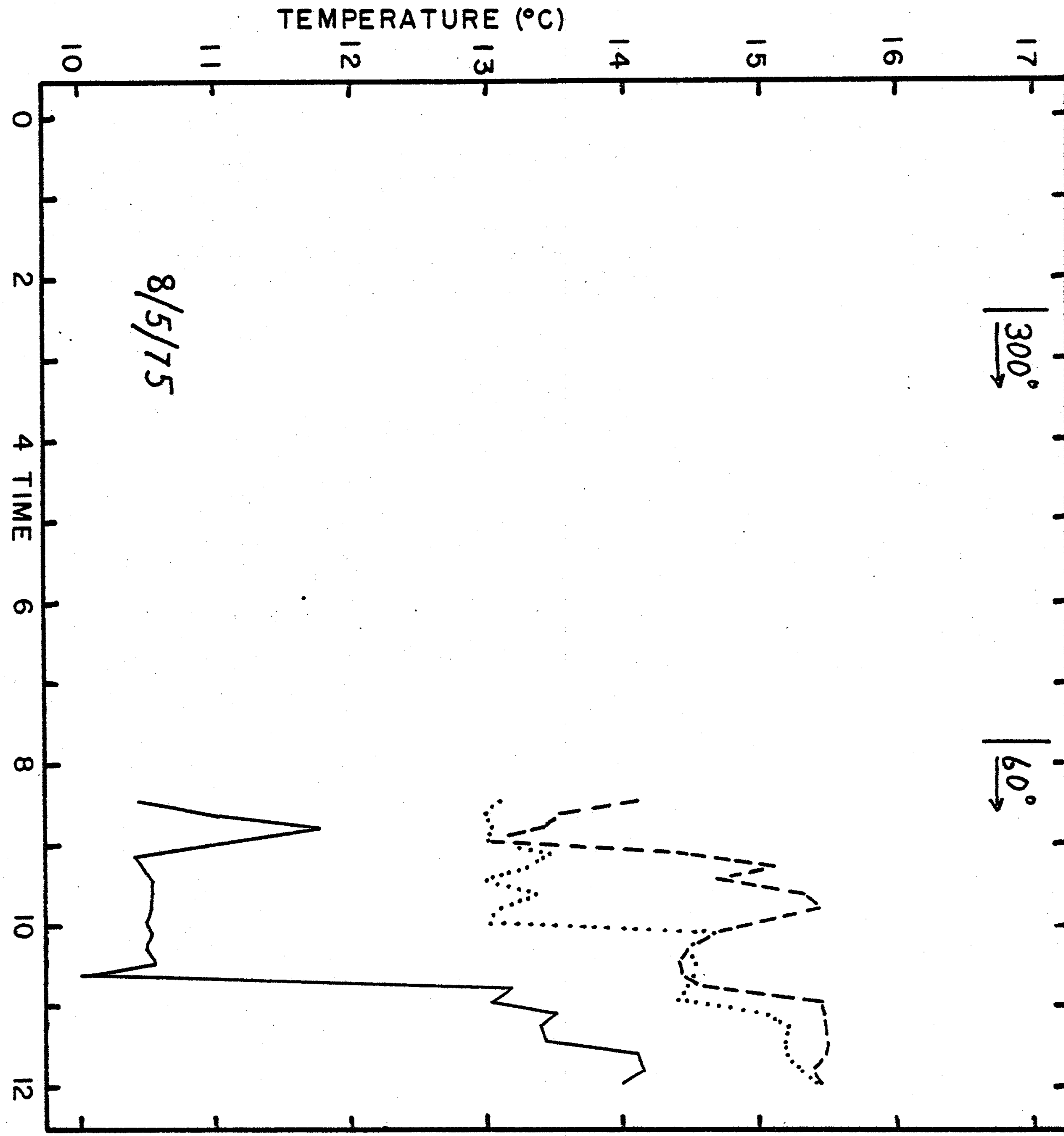


Figure 10j. Recorded Temperatures vs Time

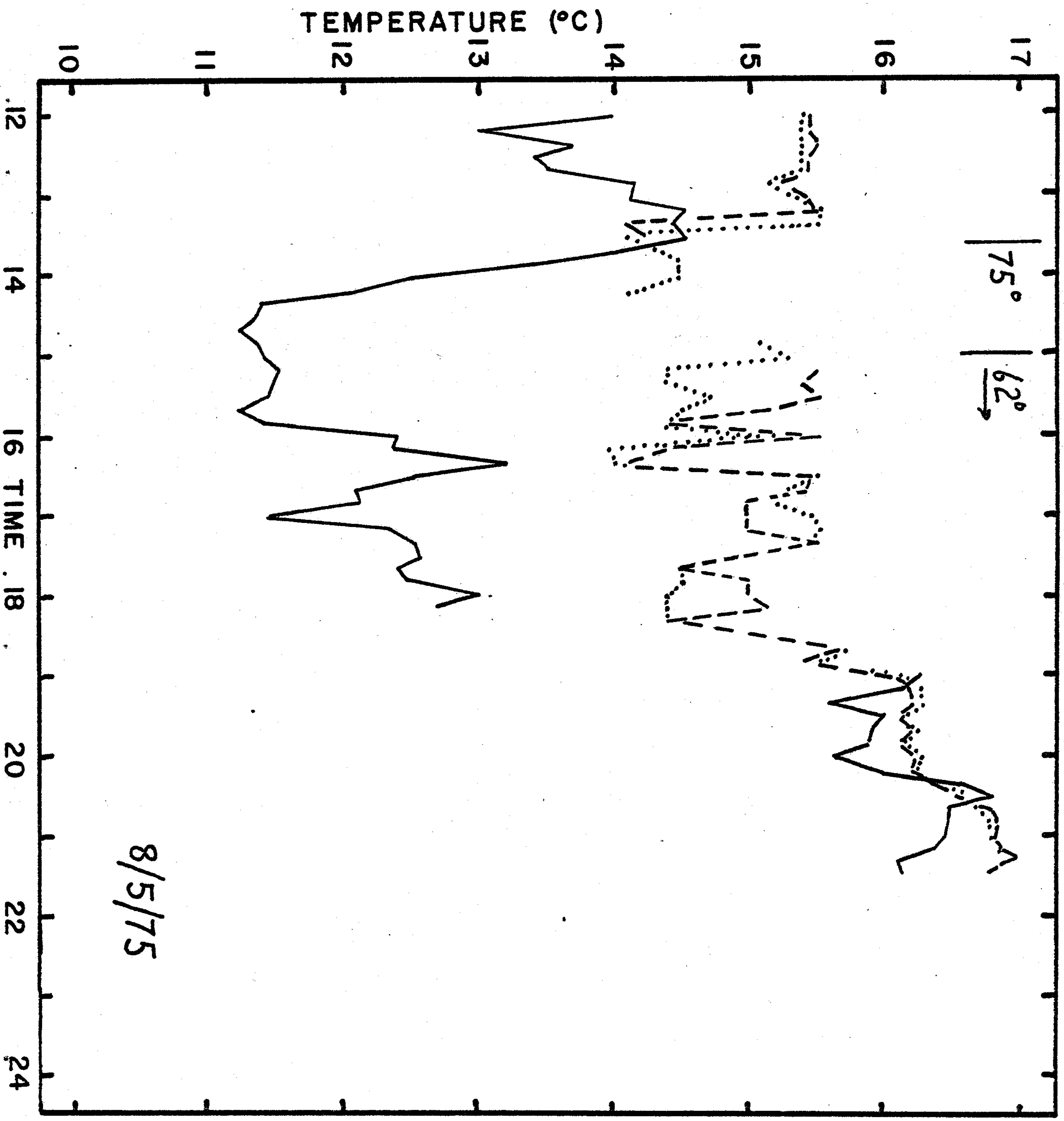


Figure 10k. Recorded Temperatures vs Time

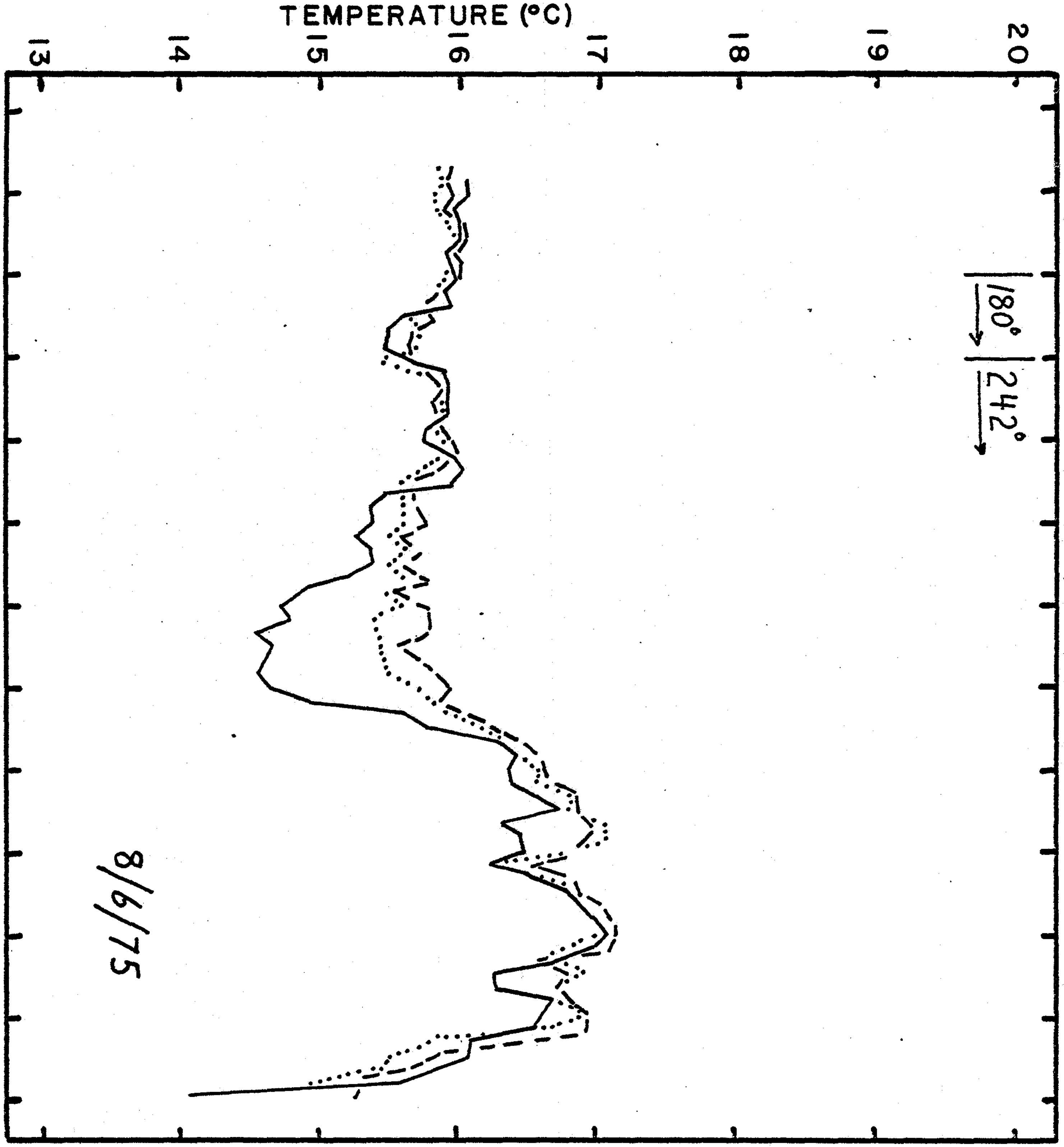


Figure 101. Recorded Temperatures vs Time

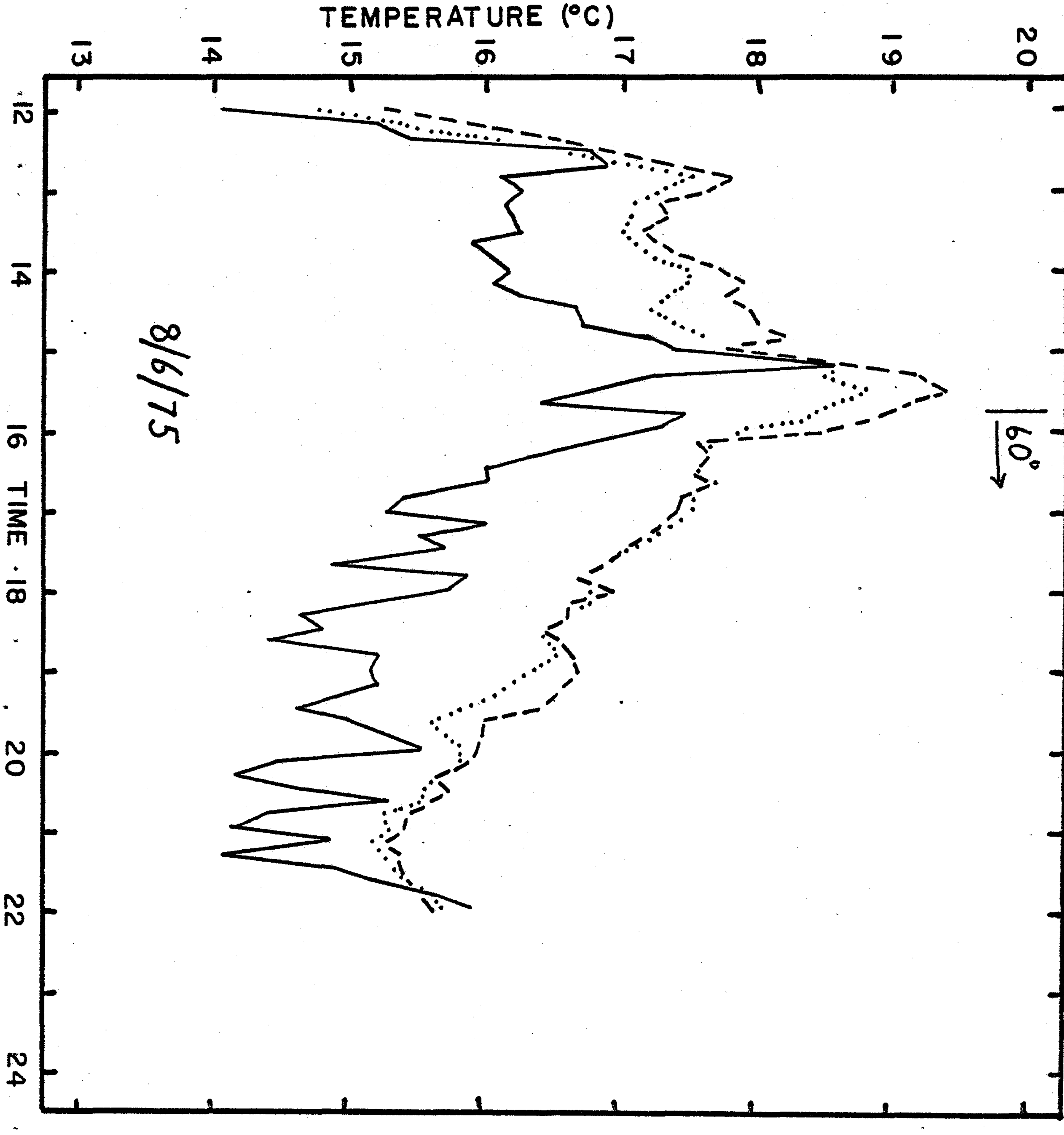


Figure 10m. Recorded Temperatures vs Time

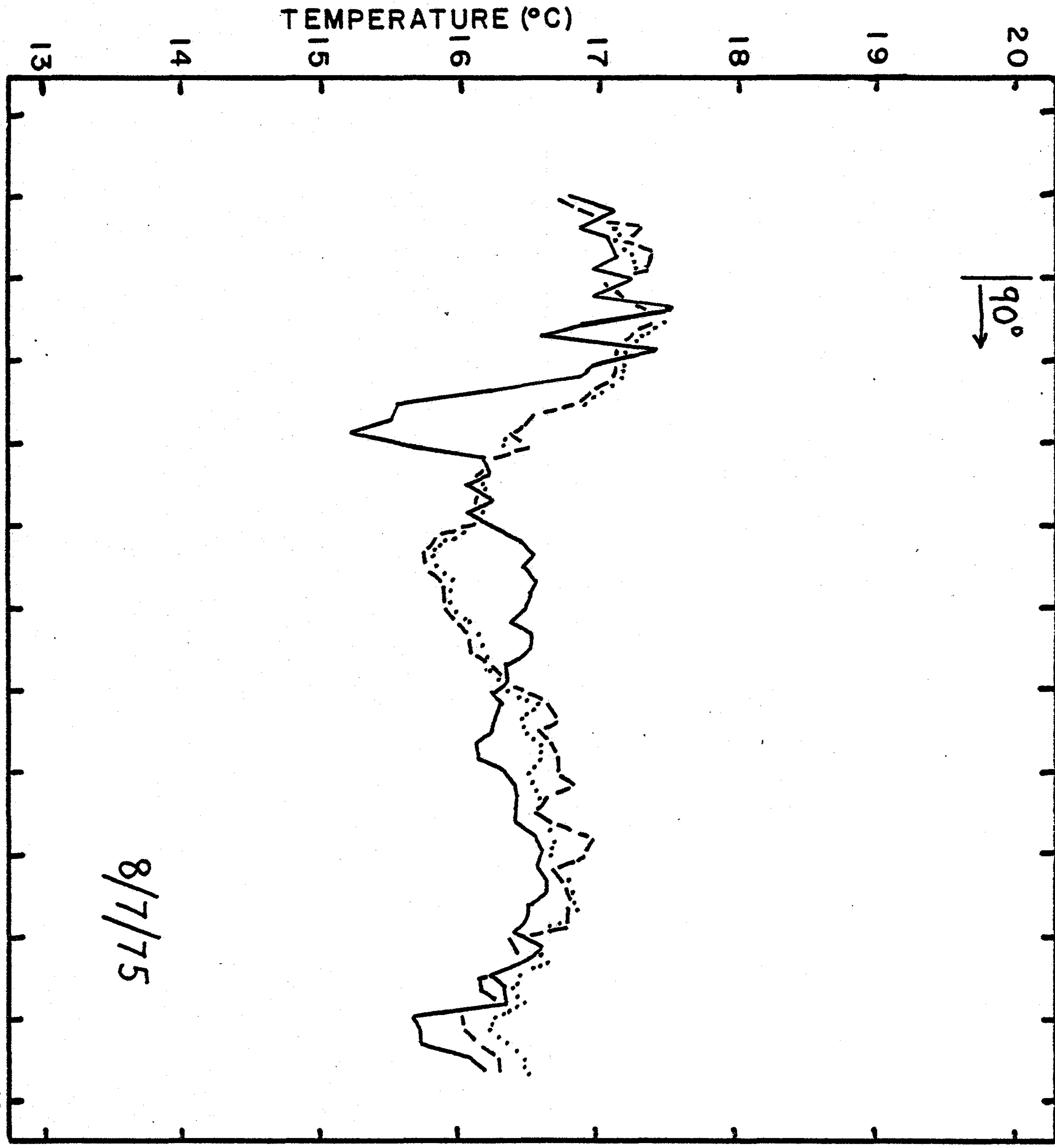


Figure 10n. Recorded Temperatures vs Time

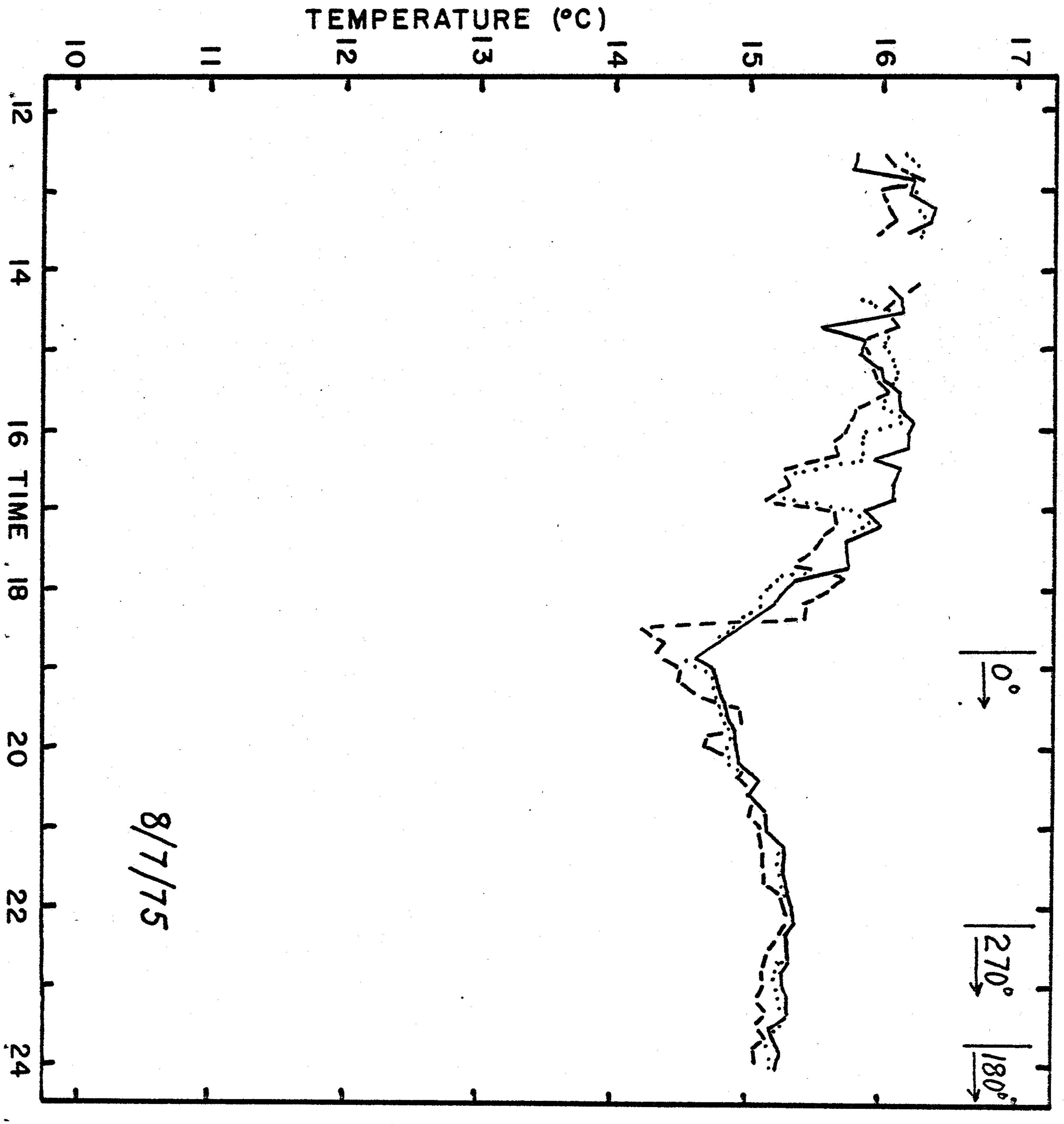


Figure 10o. Recorded Temperatures vs Time

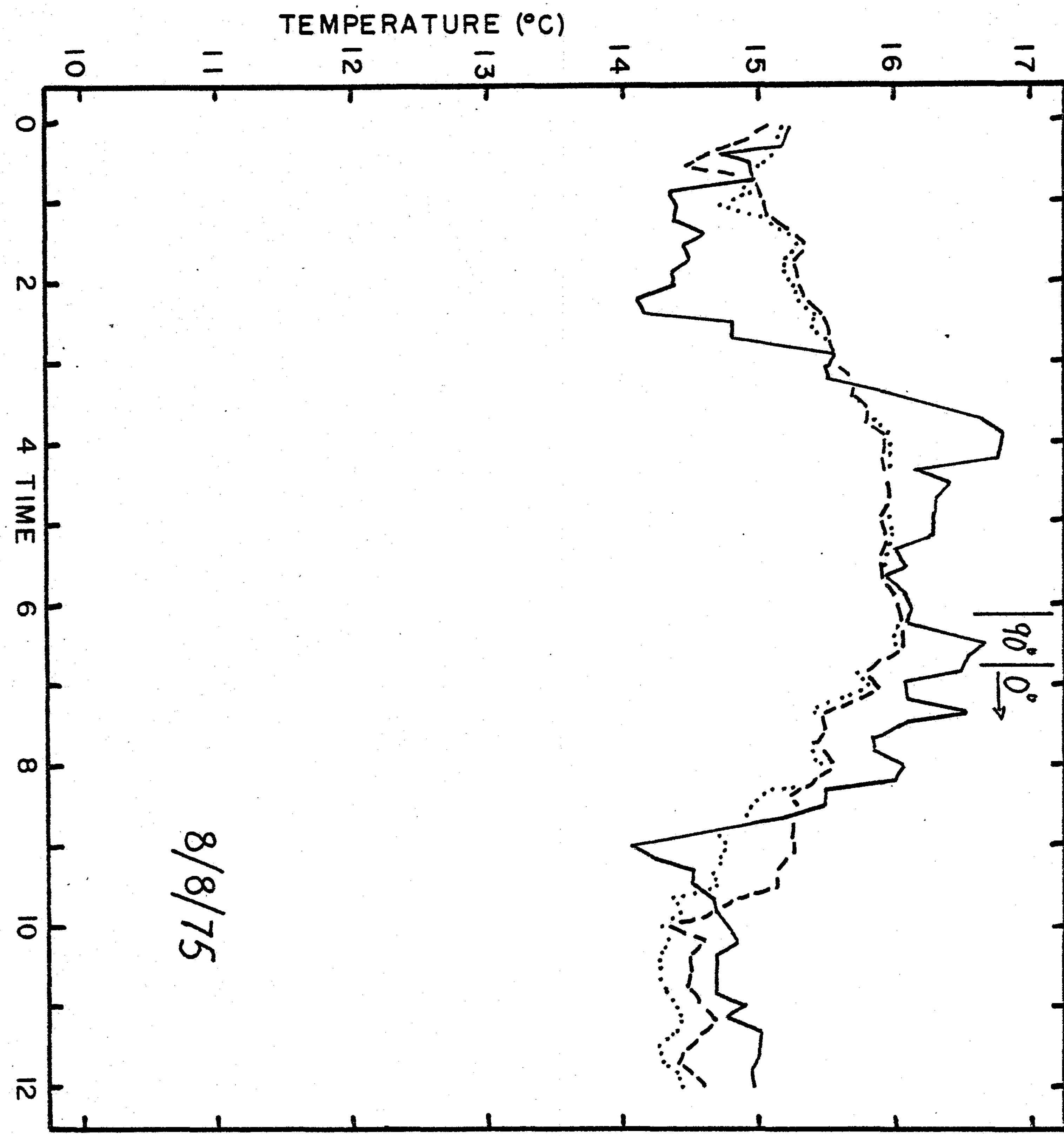


Figure 10p. Recorded Temperatures vs Time

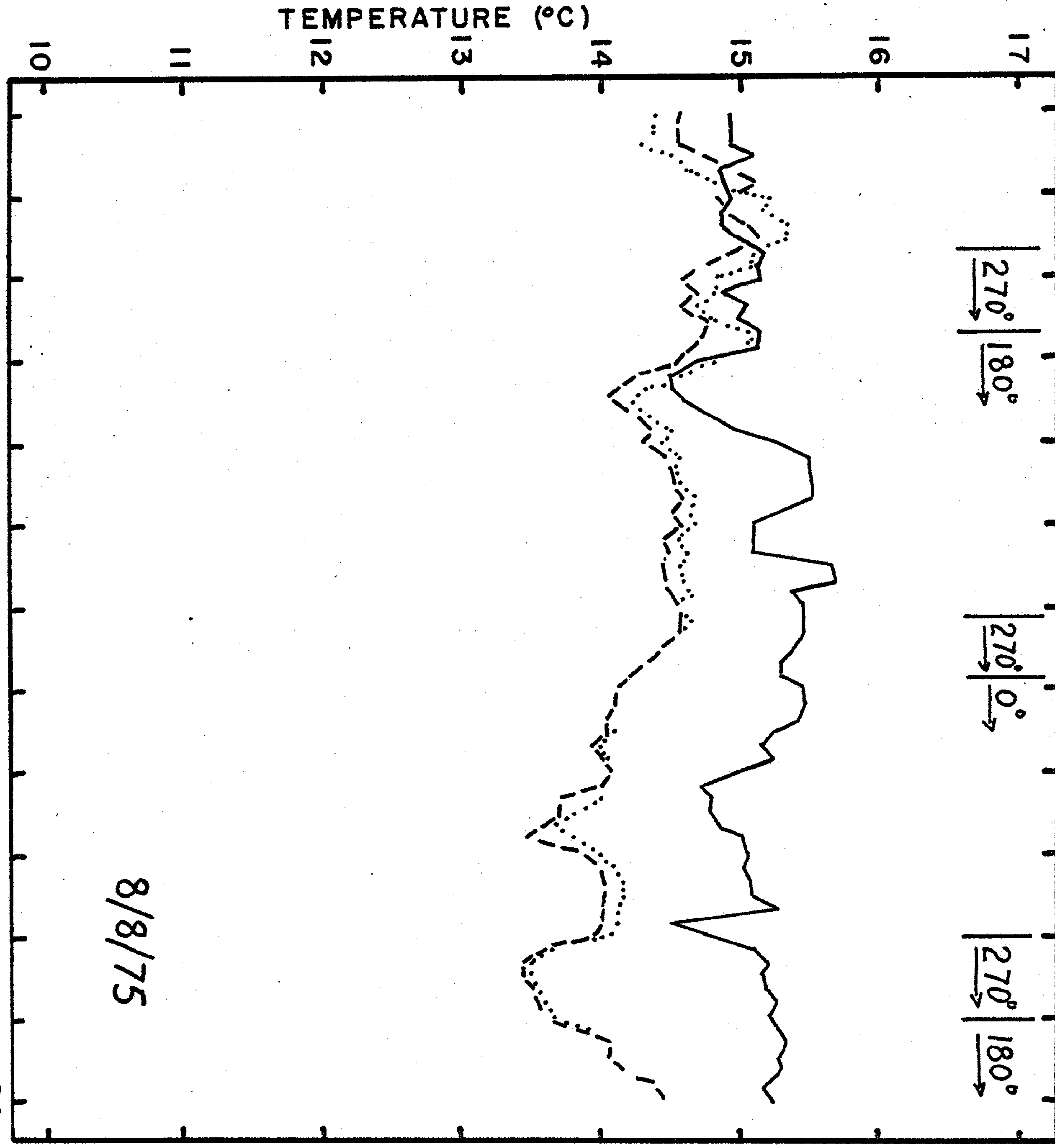


Figure 10q. Recorded Temperatures vs Time

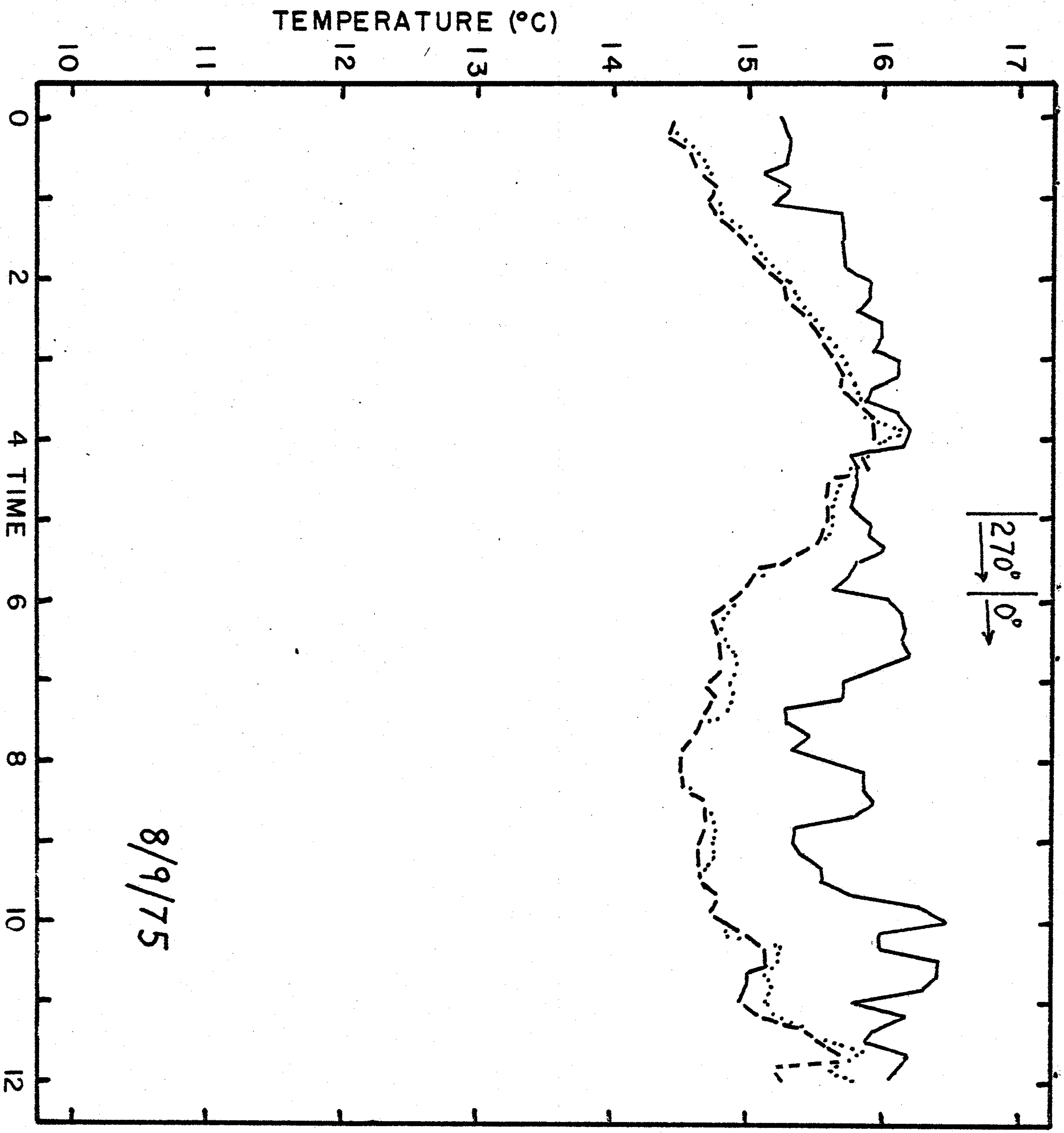


Figure 10r. Recorded Temperatures vs Time

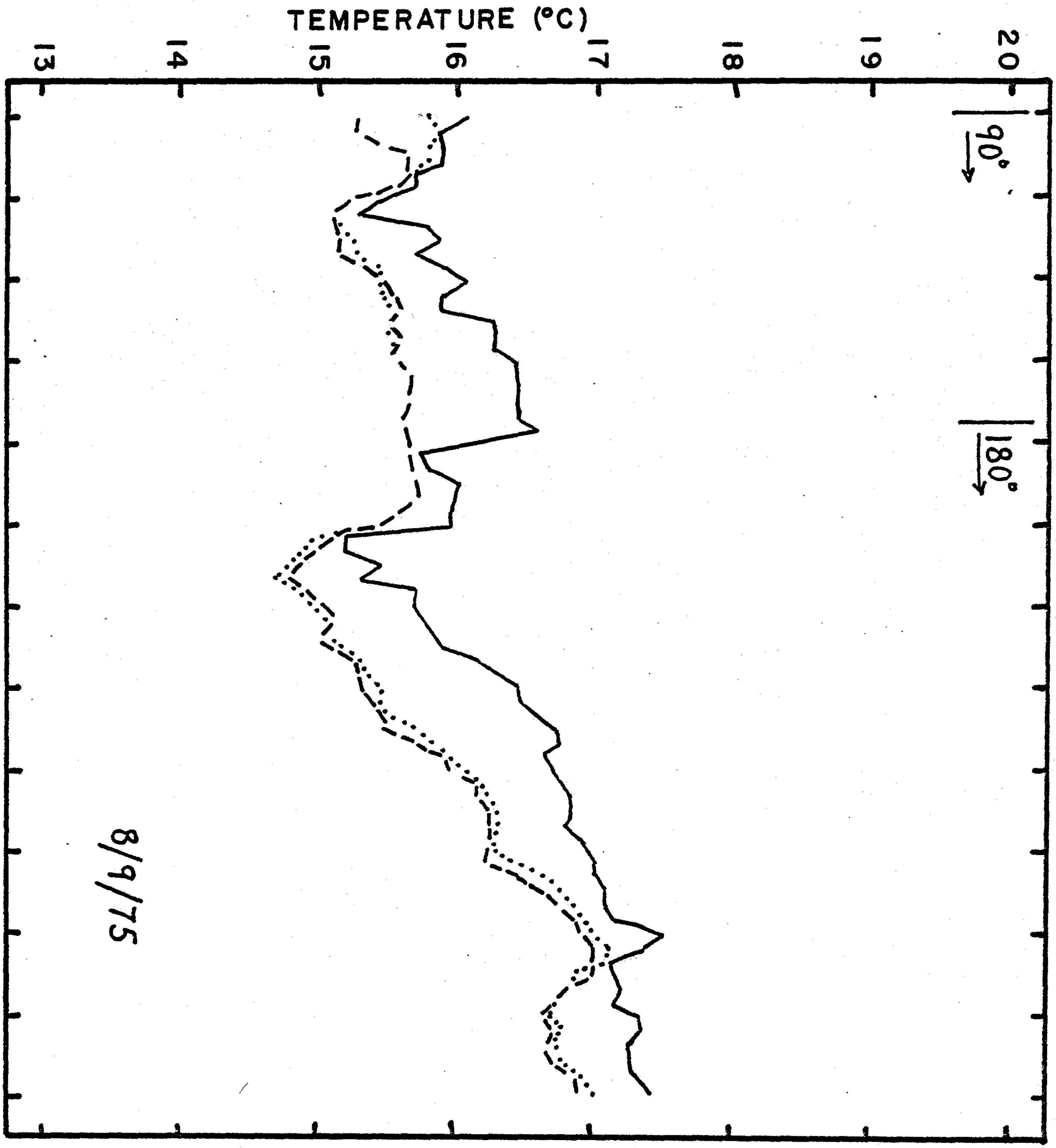


Figure 10s. Recorded Temperatures vs Time

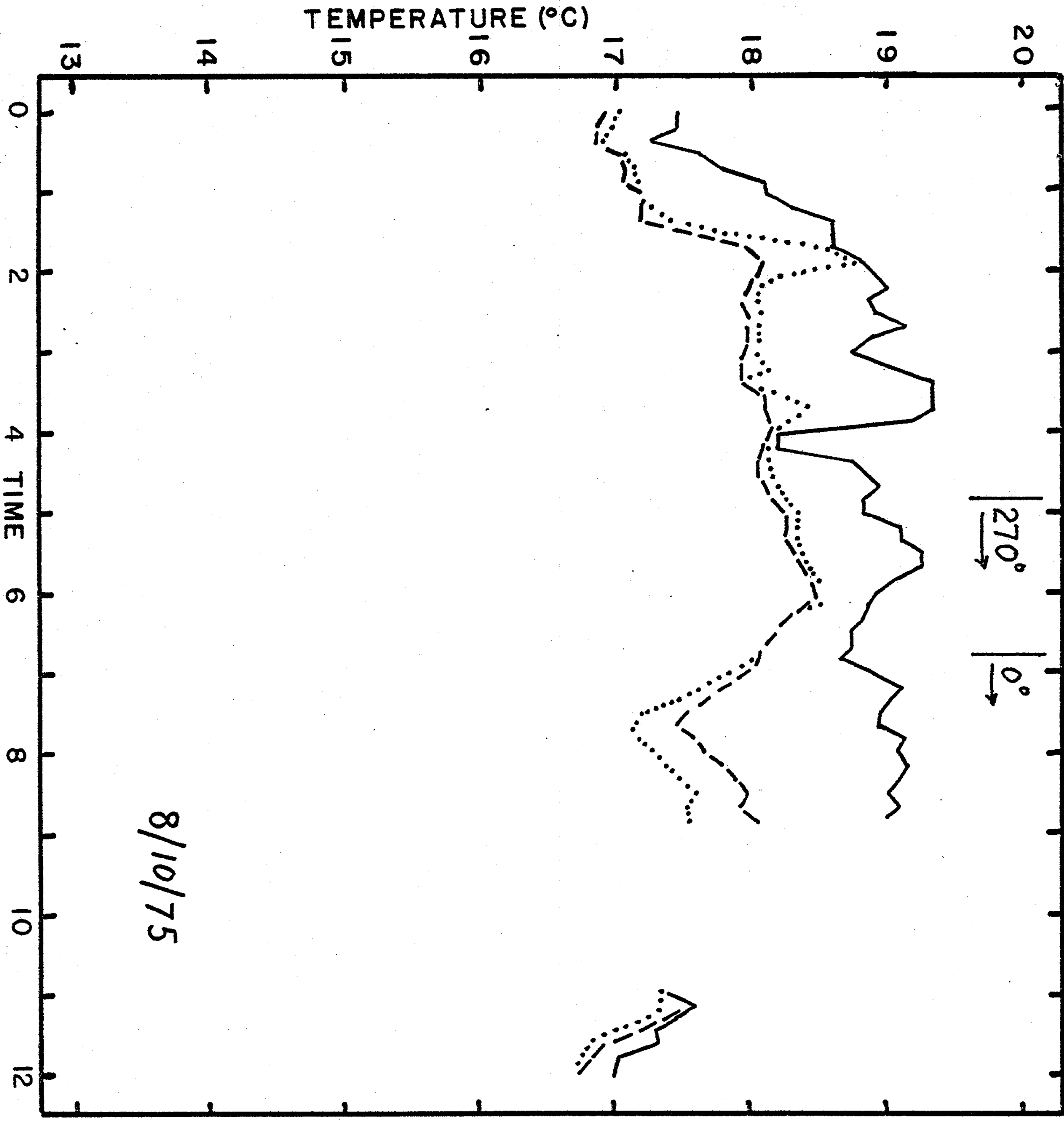


Figure 10t.   Recorded Temperatures vs Time

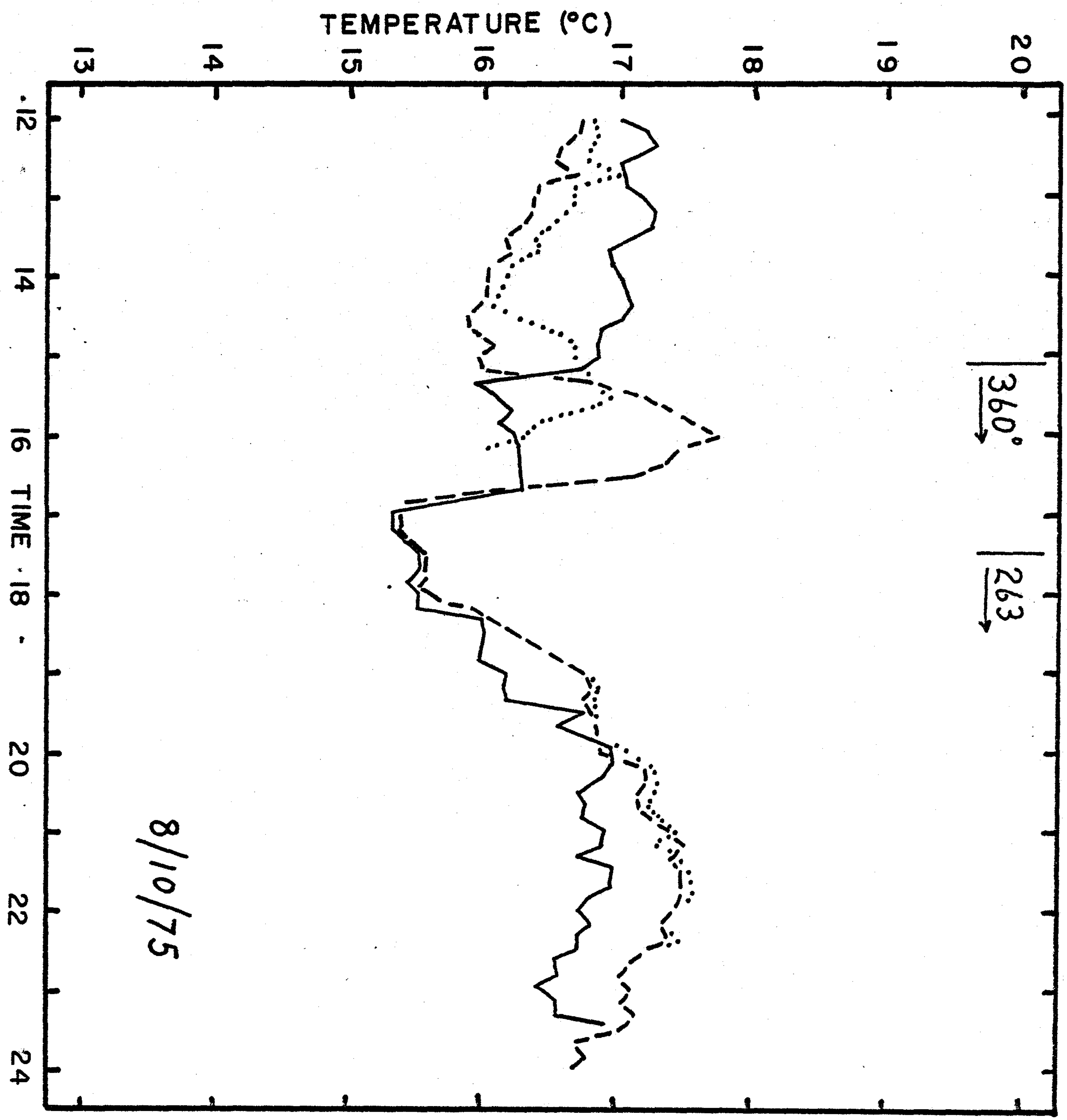
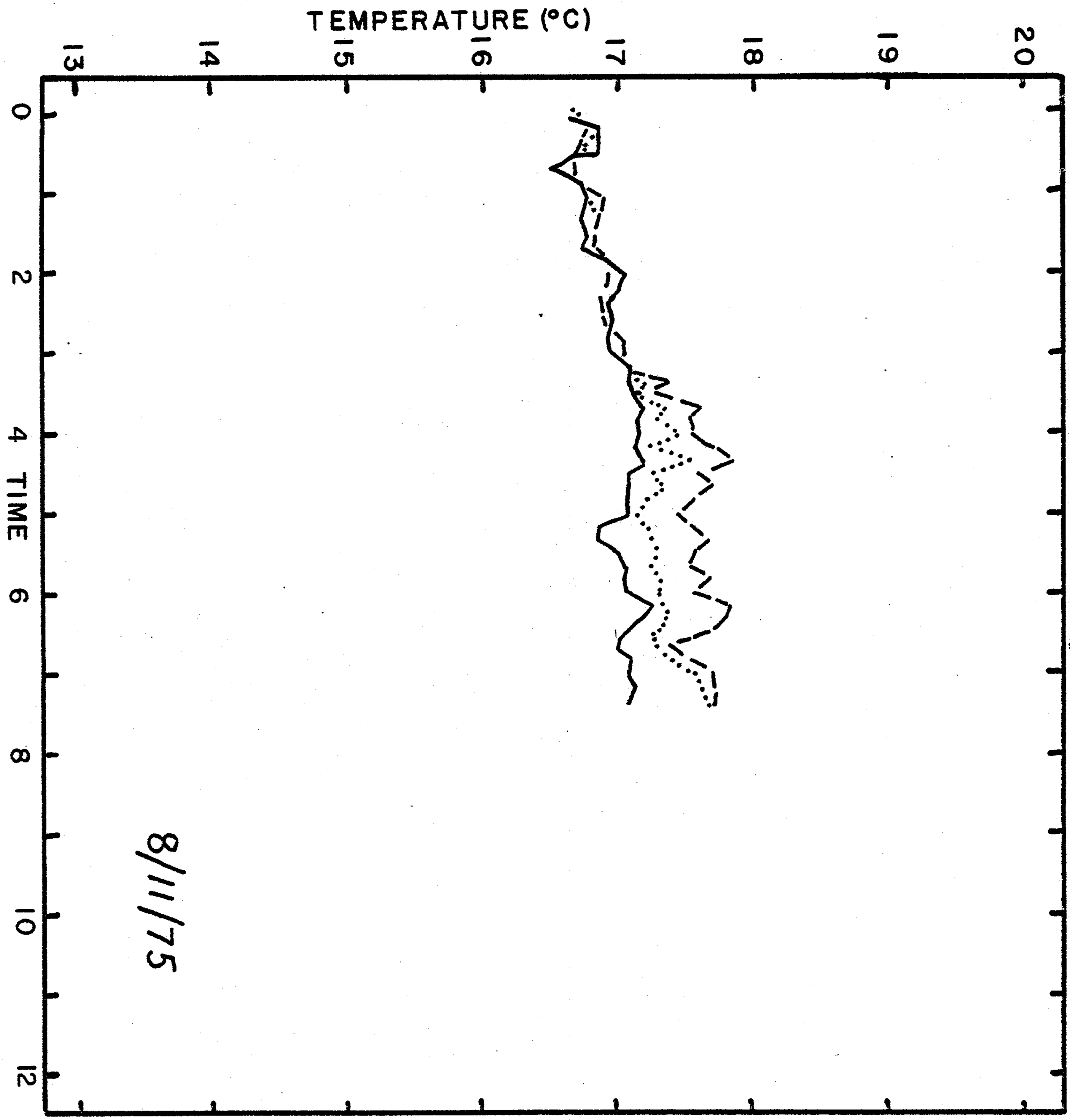


Figure 10u. Recorded Temperatures vs Time



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